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Masterproef
Feasibility of an exercise program using video-based training in institutionalized elderly suffering from dementia

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Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie
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FEASIBILITY OF AN EXERCISE PROGRAM USING VIDEO-BASED TRAINING IN INSTITUTIONALIZED ELDERLY SUFFERING FROM DEMENTIA

Drawn up according the guidelines of ‘Journal of Neurologic Physical Therapy’ (http://edmgr.ovid.com/jnpt/accounts/ifauth.htm)
Acknowledgements

I would like to thank some people for their support and help during the completion of the thesis. First of all, I like to extend my sincere gratitude to my promotor, Prof. dr. Annick Timmermans and my co-promotors Prof. dr. Peter Feys and Dr. Joke Spildooren for their great counselling and support. Also a special word of thanks to the staff of the Sint-Elisabeth nursing home, especially the director Johan Abrahams and physiotherapists, who made this feasibility study possible. I would like to thank them for the great cooperation that contributed to the success of this project. Moreover, I thank my grandmother for her participation in the study.

Thank you all for the support.
Research context
This feasibility study is situated in the geriatric, musculoskeletal and neurological rehabilitation research domain. By the aging population in our society, dementia will become a growing issue in the next few decades.1 Elderly suffering from this degenerative syndrome experience increasingly difficulties in mental and physical functioning. As the disease progresses the independence in performing daily activities decreases. In order to enhance their functional abilities, a multidisciplinary care including physiotherapy is offered in residential care centers and hospitals. Besides the administration of medication and the adjustments of nutrition, physical activity applied in an exercise program turns out to be a valuable strategy, as investigated in my Master Thesis, part I.

Given the aging population and so the increasing number of elderly in centers, the demand for staff in health care will continue to rise. In order to reduce the workload of the staff on one side and provide additional physiotherapy at the other side, a step to more technology-assisted care of the elderly might be beneficial. Group sessions led by a physiotherapist can for instance be adapted by replacing the therapist by exercises demonstrated on a flat screen. Thereby the therapist is able to overview all participants and has the possibility to correct performances if necessary, this in contrast with the usual approach of physiotherapeutic exercises performed individually in the gym room without closely guidance of a therapist. To the authors knowledge, the impact of replacing the physiotherapist by video demonstrated exercises has not yet been investigated.

Therefore, the purpose of this study is to evaluate the feasibility and suitability of a physical program, combining strength, balance, functional, endurance and flexibility exercises, based on video demonstrated exercises in institutionalized elderly suffering from dementia. The idea of this program is to let the participants practise in an autonomous manner and in this way improve their physical functioning and affect their quality of life. However, these effects will not be analyzed in this study given the pilot nature of the trial and small sample size.

This thesis is a mono-centered project (Sint-Elisabeth nursing home) written by Ite Speetjens and is led by Prof. dr. Annick Timmermans, Prof. dr. Peter Feys and Dr. Joke Spildooren. The design and methods of the research was determined in co-operation with the promotors and was further operated by myself. The recruitment, data-acquisition and data analysis was conducted completely independently along with the academic writing process. On 10 May, an abstract reporting the results of this thesis was submitted for the 11th European Union Geriatric Medicine Society congress in Oslo (http://www.eugms.org/2015.html).

Abstract

**Background and purpose:** There is evidence that exercise programs are feasible and potentially effective in persons with dementia. The impact of replacing the therapist by video demonstrated exercises has not yet been investigated. The objective of this pilot study is to evaluate the feasibility of a video-based exercise program in elderly suffering from dementia by examining (1) the adherence and (2) suitability of the program,(3) the motivation, credibility, expectations and emotions of the participants regarding the program.

**Methods:** A total of 5 participants (89.6 ± 5.08 years) suffering from moderate Alzheimer’s disease (MMSE 14.4 ± 3.44) were recruited from a nursing home. A three weeks progressive program using video-based training with musical accompaniment was performed in three weekly sessions of 30 minutes and digitally recorded to investigate the adherence and suitability of the program. After each session the Intrinsic Motivation Inventory, the Credibility Expectancy Questionnaire, and the Observed Emotion Rating Scale were conducted.

**Results:** All participants finished the program, and adherence to the prescribed sessions averaged 88.9%. Significant differences over time were found: 1) in the number of performed repetitions for functional exercises \((p=.037)\), 2) in the quality of performances of warming-up exercises \((p=.015)\), and 3) in credibility \((p=.024)\) and expectancy \((p=.022)\) regarding the program.

**Discussion:** Moderate to high adherence was demonstrated and the content of the program seemed suitable. The expectations of the participants increased, they were motivated and showed no negative emotions during the sessions.

**Conclusion:** The present study suggests that a video-based exercise program in a group of participants with Alzheimer’s disease is feasible.
Introduction

As a result of the upgraded health care over the last century, people are living longer and healthier and the number of elderly is rising worldwide. Therefore, also the incidence of the age related disease dementia increases. In 2012, dementia has been announced to be a public health priority by the World Health Organization and Alzheimer’s Disease International as there are 7.7 million new cases of dementia each year, implying a diagnosis every four seconds somewhere in the world. In 2013, 44.4 million people worldwide lived with dementia and this number is expected to increase to 75.6 million in 2030. Dementia is a progressive neurological syndrome which can manifest in different forms. The most common types in elderly are ‘Alzheimer’s disease’, ‘Vascular dementia’, ‘Frontotemporal dementia’, ‘Lewy-body dementia’ or a ‘mixed type’ with the highest incidence in elderly suffering from Alzheimer’s Disease. Impaired cognitive functions are often the main feature that characterizes dementia along with other symptoms as wandering around without a specific aim, and neuropsychiatric symptoms such as agitation, psychosis and depressive behavior. All of these symptoms can lead to a reduced independence in performing activities of daily living and reduced quality of life. These deficits lead to disabilities and eventually in advanced stages to permanent institutional care. Offering complete and combined therapy to nursing home residents in order to enhance their functional abilities is one of the fundamental objectives of the institutionalized long-term care. This is of great importance in elderly suffering from dementia as it is a degenerative syndrome and the focus is on the symptomatic treatment of the neuropsychiatric symptoms such as psychosis and depression. In addition to the administration of medication and the adaptation of nutrition, physical activity in the form of an exercise program seems to be a valuable strategy for elderly with cognitive impairments. Exercises are associated with positive treatment effects at physical, cognitive, functional and behavioral outcomes in persons with dementia and are identified as a strategy for treating the symptoms of dementia or delaying its progression.

Combined exercise programs focusing on functional, aerobic, balance, strength and flexibility exercises seem to be applicable among elderly with dementia. Evidence presented by several RCT’s indicates positive effects on functionality, balance, walking capacity, strength, daily activity performance in elderly with dementia participating in physical exercise programs. After selecting the appropriate intensity, type of exercises and frequency, the setting as well is important. Physical programs, in particular long-term programs, are more suitable and easier to organize in nursing homes due to the prolonged period of stay in these institutions. In the aging population, the demand for staff in nursing homes will further increase. Technological developments have aimed to support caregivers. For example, robots are used to decrease stress levels of nursing staff as the elderly required less supervision while interacting with the robots. Several types of robots have been developed for particular therapeutic goals in nursing homes, for instance a seal-type mental commitment robot named Paro designed to maintain long-term interaction with people. Findings suggest elderly interacting with Paro became more active. Human-interactive robots are able to provide assistance, therapy, education or enable communication. Perilli et al. (2013) studied and confirmed the effects of a different technique, namely a video prompting program with instructions to support people with mild and moderate Alzheimer’s disease during the performance of daily activities.
In comparison with the investigation of Perilli et al. (2013), the present study contains a video-based physical exercise program combined with visual instructions and background music as there is evidence that physical exercises with rhythmic musical accompaniment increase levels of participation in older adults with dementia. This program aims to affect the quality of life by improving physical functioning and performances in daily living activities. The approach of replacing the instructor by video demonstrated exercises can be an ability to offer additional physiotherapy and creates a more efficient approach in providing therapy in group sessions as the therapist has the ability to correct the performances and overview all participants.

The aim of this study is to evaluate the feasibility of a video-based exercise program by examining (1) the adherence (2) the suitability of the content of the exercise program, and (3) the motivation, credibility, expectations, emotions regarding the program, in elderly suffering from dementia.
Methods

Study design

This study was approved by the leading ethics committee of the Medical department of the University Hospital of Louvain and the local ethics committee of the Medical department of the University of Hasselt. The intervention was conducted in group context in the nursing home Sint-Elisabeth, Hasselt and was designed as a pilot and feasibility study, in continuation of a literature search.\cite{38} The overall duration of the intervention amounted 3 weeks with a session frequency of 3 times a week. Outcome measures were evaluated after each session.

Research questions

1) What is the adherence to the exercise program?
2) Is the content of the program and so the presentation of the exercises suitable for this specific population?
3) What is the motivation, credibility, expectations and emotions of the elderly regarding the program?

Study participants

Initially, the investigator, the local physiotherapist and the medical head of the department screened and discussed which five individuals were considered for inclusion. The residents who met eligibility criteria were given oral and written information along with the question if they were interested in participating. If they approved, a close family member was informed. In March, 5 participants were recruited from the nursing home after they provided written consent of the participant and a close family member. Eligible participants were institutionalized elderly over 65 years of age with a specialist diagnosis of dementia, a Mini-Mental State Examination (MMSE) score of less than 24/30 and were able to walk independently with or without a mobility aid. Individuals who met following criteria were excluded: their stay in the nursing home counted less than 3 months; they were not speaking Dutch or they had severe hearing- or visual loss such that watching television becomes impossible. The head of medical department of the enrolled residents were informed and the sessions were scheduled in the planning.

Intervention

The intervention started on Monday the 25\textsuperscript{th} of March 2015 and was performed in a group of 5 participants, supervised by the investigator. The participants practiced a screen given exercise program carried out in a part of the gym room of the nursing home. The program included a total of 9 sessions (three weeks, 3x/week on Monday, Wednesday and Friday). Each session of 30 minutes duration took place in the morning, along with the daily physiotherapeutic treatment sessions in the other part of the gym room. The exercises were displayed per USB on a 54 inch flat screen TV that was present in the gym room of the nursing home. The available space in front of the screen measured 16 m\textsuperscript{2}. Concerning the comfort of the participants, chairs with armrests were used.
The video-based exercise program

The composition, intensity, duration, frequency and length of sessions were based on exercise programs described in previous work and additional exercises were added by the investigator. The composition of the program is displayed in Table 1. In November, the exercises intended for the program were performed by a 77 year old woman and videotaped and photographed by the investigator. All photographs of different parts of the exercises were used in the information brochure which was given at the participant and a family member. The photographs for week 1 are added in Appendix 1 as an illustration. All digital recordings were compounded using Microsoft Windows Moviemaker. The music that joined the exercises were English instrumental songs of the sixties, presented in Appendix 2. The context of the exercises demonstrated by an ancient woman along with the facilitative music was intended to motivate and encourage participation.

There was a progression in difficulty level across the 9 sessions, that were divided into 3 components. In week 1, exercises began at light intensities, in week 2 and 3 the intensity or difficulty degree further increased. At the beginning of the sessions, the participants were asked to imitate the exercises, demonstrated by the woman visible on the TV-screen. Each session of the program was started with four warming-up exercises and existed out of 5 components: strength, balance, functional exercises, endurance and flexibility.

Strength exercises were all performed in sitting position during the first 3 session in week 1, with the focus on both upper and lower limbs. Each strength exercise was intended to be performed 10 times. As it was a progressive exercise program, the number of repetitions increased with an extra 10 repetitions a week while the number of exercises decreased. The load increased in the second week by performing all exercises in standing position and adding 2 manual weights of 0.5 kg each in 3 out of 6 exercises. In the final week, the number of exercises dropped further and half of the exercises were completed in sitting position, although weights were used in all four exercises. Additionally, motor dual tasks were implemented as exercises required activities of both upper and lower extremities at the same time. Balance exercises contained both static and dynamic balance exercises. In the first week, all exercises were performed with external support of the arms on their mobility aid, on the back of the chair or on the parallel walking bars. The number of exercises decreased at the start of the second week and exercises were intended to carry out without external support. Motor dual tasks were implemented in the last week, for instance clapping or crossed hitting the knees. Functional exercises were designed based on functional activities such as cycling, walking stairs and the combination of walking on stairs and combing hairs backwards. The endurance exercises were practiced by lifting the knees in standing position and accelerating at given sign. Flexibility exercises related to the head, trunk, upper and lower body and did not differ over weeks.
### Table 1: Composition of the exercise program over weeks

<table>
<thead>
<tr>
<th>Composition</th>
<th>WEEK 1</th>
<th>WEEK 2</th>
<th>WEEK 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Warming-up</strong>&lt;br&gt;(5 minutes)</td>
<td><strong>Warming-up exercises</strong>&lt;br&gt;- Ex. 1: marching in sitting position&lt;br&gt;- Ex. 2: boxing in sitting position&lt;br&gt;- Ex. 3: lifting knees in standing position&lt;br&gt;- Ex. 4: clapping hands in standing position</td>
<td><strong>Warming-up exercises (in standing position)</strong>&lt;br&gt;- Ex. 1: alternately bringing legs forward&lt;br&gt;- Ex. 2: turning arms&lt;br&gt;- Ex. 3: Y-step&lt;br&gt;- Ex. 4: boxing</td>
<td><strong>Warming-up exercises</strong>&lt;br&gt;- Ex. 1: marching while lifting arms till 180°&lt;br&gt;- Ex. 2: marching sideways and clapping hands&lt;br&gt;- Ex. 3: marching while making scissor movements with the arms&lt;br&gt;- Ex. 4: extending legs sideways while extending both arms 180° upwards</td>
</tr>
<tr>
<td><strong>Main components</strong>&lt;br&gt;(20 minutes)</td>
<td><strong>Strength exercises</strong>&lt;br&gt;- Ex. 1: alternately lifting knees&lt;br&gt;- Ex. 2: lifting knees and spread legs&lt;br&gt;- Ex. 3: alternately extending knees&lt;br&gt;- Ex. 4: feet alternately supporting on tiptoe and heel&lt;br&gt;- Ex. 5: circular movements with spreaded arms&lt;br&gt;- Ex. 6: extending arms forward&lt;br&gt;- Ex. 7: bending arms with weights</td>
<td><strong>Strength exercises</strong>&lt;br&gt;- Ex. 1: lifting legs sideways in standing position with external support&lt;br&gt;- Ex. 2: lifting legs forward in standing position with external support&lt;br&gt;- Ex. 3: transfer from sit to stand&lt;br&gt;- Ex. 4: standing on tiptoes with external support&lt;br&gt;- Ex. 5: lifting extended arms forward till 90° with weights in standing position&lt;br&gt;- Ex. 6: lifting extended arms sideways till 90° with weights in standing position&lt;br&gt;- Ex. 7: bending arms with weights in standing position</td>
<td><strong>Strength exercises (with weights)</strong>&lt;br&gt;- Ex. 1: extending knees while alternating bending arms in sitting position&lt;br&gt;- Ex. 2: forward and backward rowing in sitting position&lt;br&gt;- Ex. 3: squat&lt;br&gt;- Ex. 4: bringing alternately leg sideways while bringing both extended arms 90° sideways</td>
</tr>
<tr>
<td><strong>Static balance exercises (with external support)</strong>&lt;br&gt;- Ex. 1: tandem stand&lt;br&gt;- Ex. 2: spread stand&lt;br&gt;- Ex. 3: lifting knees</td>
<td><strong>Static balance exercises</strong>&lt;br&gt;- Ex. 1: unipodal stand with external support&lt;br&gt;- Ex. 2: tandem stand without external support&lt;br&gt;- Ex. 1: lunges without external support</td>
<td><strong>Static balance exercises (with reduced external support)</strong>&lt;br&gt;- Ex. 1: standing on tiptoes&lt;br&gt;- Ex. 2: unipodal stand&lt;br&gt;- Ex. 1: crossed tapping knees while lifting them</td>
<td><strong>Dynamic balance exercise</strong>&lt;br&gt;- Ex. 1: lunges without external support</td>
</tr>
<tr>
<td><strong>Dynamic balance exercise</strong>&lt;br&gt;- Ex. 1: lunges with external support</td>
<td><strong>Dynamic balance exercise</strong>&lt;br&gt;- Ex. 1: lunges without external support</td>
<td><strong>Dynamic balance exercise</strong>&lt;br&gt;- Ex. 1: crossed tapping knees while lifting them</td>
<td><strong>Dynamic balance exercise</strong>&lt;br&gt;- Ex. 1: lunges without external support</td>
</tr>
<tr>
<td><strong>Functional exercise</strong>&lt;br&gt;- Ex. 1: cycle movements in sitting position</td>
<td><strong>Functional exercise</strong>&lt;br&gt;- Ex. 1: lifting knees while marching</td>
<td><strong>Functional exercise</strong>&lt;br&gt;- Ex. 1: lifting knees while marching + moving arms around head</td>
<td><strong>Functional exercise</strong>&lt;br&gt;- Ex. 1: lifting knees while marching + moving arms around head</td>
</tr>
<tr>
<td><strong>Endurance exercise</strong>&lt;br&gt;- Ex. 1: marching with accelerations</td>
<td><strong>Endurance exercise</strong>&lt;br&gt;- Ex. 1: marching with accelerations</td>
<td><strong>Endurance exercise</strong>&lt;br&gt;- Ex. 1: marching with accelerations</td>
<td><strong>Endurance exercise</strong>&lt;br&gt;- Ex. 1: marching with accelerations</td>
</tr>
<tr>
<td><strong>Flexibility exercises</strong>&lt;br&gt;- Ex. 1: neck muscles&lt;br&gt;- Ex. 2: trunk&lt;br&gt;- Ex. 3A + 3B: shoulders&lt;br&gt;- Ex. 4A + 3B: wrists&lt;br&gt;- Ex. 5: calf muscles&lt;br&gt;- Ex. 6A + 6B: ankles</td>
<td><strong>Flexibility exercises</strong>&lt;br&gt;- Ex. 1: neck muscles&lt;br&gt;- Ex. 2: trunk&lt;br&gt;- Ex. 3A + 3B: shoulders&lt;br&gt;- Ex. 4A + 3B: wrists&lt;br&gt;- Ex. 5: calf muscles&lt;br&gt;- Ex. 6A + 6B: ankles</td>
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</tr>
</tbody>
</table>
Outcome measures

The objective of the present study is to evaluate the feasibility and suitability of a video-based exercise program in elderly suffering from dementia. Secondary analyses were applied to assess the motivation, credibility, expectations and emotions of the elderly regarding the program.

The baseline measurements contained age, sex, Mini Mental Stage Examination (MMSE) score, use of walking aids, number of drugs, date of diagnosis, residential stay (days) and the score at the Geriatric Depression Scale (GDS). A lower total score at the GDS indicates less depression and is a valid, reliable and specific scale for elderly with dementia.

Primary outcomes

To answer the question if the program is feasible in this specific population, following data were collected. Adherence was evaluated based on the number of (1) subjects who completed the entire program, (2) presence over the complete program, (3) effective performed exercises over the 3 weeks. Data were presented as percentage, mean score of all participants with standard deviation and individual values for all outcomes. All necessary calculations were completed in Excel.

To evaluate the content suitability of the program, the quality and quantity of the participants’ performances were taken into account. Based on the recorded tapes, the investigator observed each session repeatedly and scored the amount of each activity during exercises on a 4-point scale. Furthermore, the performances were compared with the offered visual instructions shown on TV and were scored on a 4-point scale. Total score at each of the 6 components ‘warming-up’, ‘strength’, ‘static balance’, ‘dynamic balance’, ‘functional exercises’, ‘endurance’ and ‘flexibility’ consisted of scores on each exercise of that component. Median score per participant per week was used for analyses.

Secondary outcomes

One questionnaire, the Observed Emotion Rating Scale (OERS), was administered only by the local investigator. Emotions were observed as demented elderly have a diminished ability to articulate verbally their feelings. The questionnaire evaluated the positive (pleasure, interest/alertness) and negative mood (anger, anxiety, sadness) by observing the extent or duration of facial expressions and body movements. Each subscale had a minimal score of 1 and a maximum score of 5. High scores on the positive mood scales (pleasure, alertness) were positive. The lower the score on the other 3 negative mood subscales, the better. The median per participant per week was used for analyses.

Furthermore two questionnaires were questioned immediately after all 9 sessions to each participant. The first questionnaire, the Intrinsic Motivation Inventory, evaluated the degree of motivation and feelings of the participants regarding the exercise program. This instrument contains 7 subscales, of which in this case 5 were used (1) interest/enjoyment (2) perceived competence (3) effort/importance (4) pressure/tension and
perceived choice. The last 2 subscales ‘usefulness’ and ‘experiences of relatedness’ were omitted for the reason that they were not applicable or they were scored in a different manner. As it was based on the English version, all 30 questions were translated to Dutch and the satisfaction was assessed in relationship with the program. To score this instrument, all items shown with an (R) had to be reversed by subtracting the item score from 8. The resulting number corresponded to the item score. Subscale scores used for analyses were calculated by averaging across all items of that scale. The median per participant per week was used for analyses. Both validity and reliability of the IMI have been established in various populations.

The second questionnaire, the Credibility Expectancy Questionnaire, assessed the impressions and feelings of the participants experienced during the program. The instrument contained a total of 6 questions. Four questions had to be answered in terms of what they thought, 2 questions in terms of what they felt. Question 1, 2 and 3 belong to the subscale ‘credibility’, question 4, 5 and 6 belong to the subscale ‘expectancy’. To score this instrument, four questions were scored with a 9-point scale, 2 questions were answered with a percentage range between 0 and 100 and this number was divided by 12,5 and added with 1. The maximum total score of both subscales ‘credibility’ and ‘expectancy’ amounted 27. The median per participant per week was used for analyses. The questionnaire demonstrated good test-retest reliability and a high internal consistency within each factor.

The baseline measurements and evaluations after each session were performed inside the nursing home.

Statistical analyses
SPSS Statistics v. 22 was used for the analyses of the data. Statistical comparison over time was performed using Friedman two-way analysis of variance by ranks (α=.05) to test whether there was a significant change. Furthermore, the multiple comparison between different test moments (week 1-week 2- week 3) was conducted using the Wilcoxon signed rank test (Bonferri correction, α=.0167). These two comparisons were applied for the analyses of the emotions, credibility, expectancy, motivation, quantity and quality. All participants recruited at baseline were included in the data analyses. An imputation strategy was used to fill in missing data. A number of data was lacking due to the fact that participants were absent or not visible on the video recordings. As each week consisted of 3 equal sessions, information from related observations were used to fill up missing values for sessions of the same week. Data were presented as median with interquartile range with 95% CI given for all outcomes.
Results

A total of 5 participants were recruited from the same nursing home, Sint-Elisabeth in Hasselt. Participants’ characteristics are presented in Table 2. All participants were female elderly with a mean age of 89.6 (SD 5.08). They were all suffering from Alzheimer’s disease in a moderate stage, diagnosed by a specialist and severity based on the MMSE score which ranged between 11 and 20. The MMSE is a valid and reliable instrument in testing cognitive functions in people with dementia, however it cannot provide a final diagnosis of any individual. The maximum score is 30, a lower score indicates a higher cognitive impairment. 4 out of 5 participants constantly use a walking aid, in particular walking frames with 4 wheels. They are able to walk short distances without these devices. The mean score of the group on the Geriatric Depressions Scale is below 5, that demonstrates there is no signal of depression in this sample. Residential stay is calculated from date of arrival till the first of April, 2015 and averaged 1064.4 days (SD 837.94) which implies their living environment remained stable for a prolonged period.

Table 2. Baseline Characteristics of Participants (n=5)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean (SD)</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td>89.6 (5.08)</td>
<td>96</td>
<td>83</td>
<td>88</td>
<td>86</td>
<td>95</td>
</tr>
<tr>
<td>n, gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5, female</td>
</tr>
<tr>
<td>Functional assessments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mini-Mental State Examination (0-30)</td>
<td>14.4 (3.44)</td>
<td>13</td>
<td>14</td>
<td>21</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>Geriatric Depression Scale (0-15)</td>
<td>2.2 (1.8)</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Diagnoses and medical conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date of diagnosis (months)</td>
<td>28.6 (10.855)</td>
<td>38</td>
<td>29</td>
<td>17</td>
<td>16</td>
<td>43</td>
</tr>
<tr>
<td>Number of drugs</td>
<td>8 (2.37)</td>
<td>11</td>
<td>9</td>
<td>4</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Use of walking aids, n</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Residential stay (days)</td>
<td>1064.4 (837.94)</td>
<td>1864</td>
<td>121</td>
<td>93</td>
<td>1166</td>
<td>2078</td>
</tr>
</tbody>
</table>

Abbreviations: SD = standard deviation, P = participant

Feasibility

Adherence

All 5 participants finished the program and completed on average 88.9% of the prescribed sessions. Individual values of training adherence amounted 100% in two subjects, 77.8% in two subjects and 88.9% in one subject. In the first week there were no absences, in the second week there were always 4 participants per session present. In the final week there was one absentee on Tuesday and on Wednesday. The Monday session in week 3 had to be performed on Tuesday due to a holiday. Reasons for absence at maximum two sessions were a doctor’s visit or illness and were not related to refused participations as they were all willing to move to the gym room. Although the active participation during all sessions differed among the participants, the overall participation averaged 84.11% (SD 21.79%) with individual values vary from 46.12% to 99.09%.
Quantity of performances

The number of exercises varied among the type of exercise and so the maximum scores (Table 3) and cut-off scores also differed (red lines in Figure 1). The boxplots in Figure 1 present the highest and lowest individual scores, the median of all individual scores and the interquartile range for each type of exercise during the 3 weeks. As the median displayed with a bold line in the boxplot is above the red line, scores were considered positive in all type of exercises: warming-up (>6), strength (>10.5), static balance (>4.5), dynamic balance (>1.5), functional (>1.5), endurance (1.5) and flexibility (>13.5). The differences found over and between weeks are displayed in Table 3. A significant difference was found in the Friedman analysis when the number of performed repetitions in functional exercises (p=.037) were compared over the different weeks. A slight decreasing trend of the median was observed in Figure 1 in the final week. No significant differences were found in number of performed repetitions over time for next type of exercises: warming up (p=.424), strength (p=.368), static balance (p=.223), dynamic balance (p=.779), endurance (p=.670) and flexibility (p=.623). Multiple comparison between weeks revealed no significant differences (p>.0167).

Table 3. Changes in quantity (number of performed repetitions) scores over time (week 1, week 2, week 3) and between weeks.

<table>
<thead>
<tr>
<th>Exercise Type</th>
<th>Median (IQR)/maximum score</th>
<th>Friedman two-way analysis α=.05</th>
<th>Wilcoxon signed rank test, α=.0167</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Week 1</td>
<td>Week 2</td>
<td>Week 3</td>
</tr>
<tr>
<td>Warming-up exercises</td>
<td>9(8;10)/12</td>
<td>8(6;10)/12</td>
<td>7(4;12)/12</td>
</tr>
<tr>
<td>Strength exercises</td>
<td>19(19;19)/21</td>
<td>16(14;19)/21</td>
<td>15.75(12,25;21)/21</td>
</tr>
<tr>
<td>Static balance exercises</td>
<td>6(3;6)/9</td>
<td>6(3;9)/9</td>
<td>9(0;9)/9</td>
</tr>
<tr>
<td>Dynamic balance exercises</td>
<td>2(2;3)/3</td>
<td>3(3;3)/3</td>
<td>4(3;3)/3</td>
</tr>
<tr>
<td>Functional exercises</td>
<td>3(2;3)/3</td>
<td>3(3;3)/3</td>
<td>2(1;2)/3</td>
</tr>
<tr>
<td>Endurance exercises</td>
<td>2(2;3)/3</td>
<td>3(2;3)/3</td>
<td>2(0;3)/3</td>
</tr>
<tr>
<td>Flexibility exercises</td>
<td>2(21,25)/27</td>
<td>22(21,22)/27</td>
<td>22(21,25)/27</td>
</tr>
</tbody>
</table>

Note: interquartile range (IQR) presented as (Q1;Q3)

Figure 1. Changes in quantity (number of performed repetitions) scores over time (week 1, week 2, week 3). The boxplots present the highest and lowest score, the median and interquartile range as displayed in Table 3. The red line indicates the cut-off score for each type of exercise.
Quality of performances

The different maximum scores of all types of exercises are presented in Table 4. The highest and lowest scores are displayed in the boxplots in Figure 2, along with the medians and interquartile ranges. Both Figure 2 and Table 4 show positive median values on next few types of exercises: warming-up (≥6), strength (>10.5), functional (>1.5), endurance (>1.5), flexibility (>13.5) as the median scores are located above the cut-off scores. Median values were negative in week 1 for static balance exercises (<4.5) and in week 3 for dynamic balance exercises (<1.5) as the median is located below the cut-off scores. Differences, presented in Table 4, were significant in comparing the quality of performances of the warming-up exercises over weeks (p=.015), there was a decreasing trend of the median value in week 2 and was stabilized till week 3. Differences found in quality of performances in strength exercises (p=.128), static balance exercises (p=.494), dynamic balance exercises (p=.120), functional (p=.074), endurance (p=.584) and flexibility exercises (p=.692) were not significant over time. Differences analyzed with the Wilcoxon signed rank test between weeks were not significant in all types of exercises (p>.0167).

Table 4. Changes in quality (of performances) scores over time (week 1, week 2, week 3) and between weeks.

<table>
<thead>
<tr>
<th>Exercise Type</th>
<th>Median (IQR)/maximum score</th>
<th>Friedman two-way analysis α=.05</th>
<th>Wilcoxon signed rank test, α=.0167</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Week 1</td>
<td>Week 2</td>
<td>Week 3</td>
</tr>
<tr>
<td>Warming-up exercises</td>
<td>10(8;11)/12</td>
<td>6(6.6;12)</td>
<td>6(3.9;12)</td>
</tr>
<tr>
<td>Strength exercises</td>
<td>16(15;19)/21</td>
<td>13(15;19)/21</td>
<td>14(10.5;14)/21</td>
</tr>
<tr>
<td>Static balance exercises</td>
<td>4(3.4;9)</td>
<td>4.5(3.6;9)</td>
<td>6(0;9)/9</td>
</tr>
<tr>
<td>Dynamic balance exercises</td>
<td>2(1;3)/3</td>
<td>2(2.3;3)</td>
<td>1(1.2)/3</td>
</tr>
<tr>
<td>Functional exercises</td>
<td>3(2.3;3)</td>
<td>2(2.3;3)</td>
<td>2(2.2;3)</td>
</tr>
<tr>
<td>Endurance exercises</td>
<td>2(2.3;3)</td>
<td>2(2.2;3)</td>
<td>2(0.3;3)</td>
</tr>
<tr>
<td>Flexibility exercises</td>
<td>16(13;18)/27</td>
<td>17(14;21)/27</td>
<td>19(16;20)/27</td>
</tr>
</tbody>
</table>

Note: interquartile range (IQR) presented as (Q1;Q3)

Figure 2. Changes in quality (of performances) scores over time (week 1, week 2, week 3). The boxplots present the highest and lowest score, the median and interquartile range as displayed in Table 4. The red line indicates the cut-off score for each type of exercise.
Motivation

Each subscale of the Intrinsic Motivation Inventory had a maximum score of 7. The medians with the interquartile ranges for each subscale are presented in Table 5 and Figure 3. The analyzed differences over and between weeks are shown in Table 5. It is apparent that the medians of all individual scores on the subscales ‘interest-enjoyment’, ‘perceived competence’, ‘effort-importance’, ‘perceived choice’ were positive over time as it was higher than the cut-off scores indicated with a red line in Figure 3 (> 3.5). De medians of all individuals on the subscale ‘tension-pressure’ were positive too as the median was lower than the cut-off score (<3.5). Results demonstrated in Table 5 found no significant differences for the Intrinsic Motivation Inventory over time: ‘interest-enjoyment’ (p=.678), ‘perceived competence’ (p=.249), ‘effort-importance’ (p=.838), ‘tension-pressure’ (p=.210), ‘perceived choice’ (p=.113). No differences were found with multiple comparison analyses between weeks (p>.0167).

Table 5. Changes in Intrinsic Motivation Inventory (IMI) scores over time (week 1, week 2, week 3) and between weeks.

<table>
<thead>
<tr>
<th></th>
<th>Median (IQR)</th>
<th>Friedman two-way analysis α=.05</th>
<th>Wilcoxon signed rank test, α=.0167</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Week 1</td>
<td>Week 2</td>
<td>Week 3</td>
</tr>
<tr>
<td>Interest-enjoyment</td>
<td>5.43(5.43;5.57)</td>
<td>5.57(5.43;5.57)</td>
<td>5.57(5.57;5.71)</td>
</tr>
<tr>
<td>Perceived competence</td>
<td>5.50(4.83;5.67)</td>
<td>5(4.67;5.17)</td>
<td>5(4.67;5.5)</td>
</tr>
<tr>
<td>Effort-importance</td>
<td>5.80(5.65;5.8)</td>
<td>5(5.6;5.8)</td>
<td>5(5.2;5.6)</td>
</tr>
<tr>
<td>Tension-pressure</td>
<td>1.40(1.2;1.4)</td>
<td>1.20(1.2;1.8)</td>
<td>1.20(1.1;1.4)</td>
</tr>
<tr>
<td>Perceived choice</td>
<td>6.57(6.57;6.57)</td>
<td>6.43(6.29;6.43)</td>
<td>6.57(6.57;6.57)</td>
</tr>
</tbody>
</table>

Note: interquartile range (IQR) presented as (Q1;Q3)

Figure 3. Changes in Intrinsic Motivation Inventory (IMI) scores over time (week 1, week 2, week 3). The boxplots present the highest and lowest score, the median and interquartile range as displayed in Table 5. The red line indicates the cut-off score (3.5).
Credibility and Expectancy

The results of the Credibility and Expectancy Questionnaire are presented in Table 6 and Figure 4. The maximum score on both Credibility and Expectancy was 27. Figure 4 visually displays the distribution of scores over time for all types of exercises and contains the highest and lowest score, the median and cut-off scores. The median scores of all individual values on the items of credibility and expectancy were positive over time (>13.5), except the negative median score observed in the expectancy subscale in the first week (<13.5). The statistical results of the analyses showed in Table 6 revealed significant differences over time for the credibility \((p=.024)\) and for the expectancy \((p=.022)\) of the participants regarding the program. A rising trend as seen in Figure 4 was observed in both credibility and expectancy with a decrease in week 3 for credibility. The multiple comparison analyses between weeks found no differences \((p>.0167)\).

Table 6. Changes in Credibility and Expectancy Questionnaire (CEQ) scores over time (week 1, week 2, week 3) and between weeks.

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Median (IQR)</th>
<th>Friedman two-way analysis (\alpha=.05)</th>
<th>Wilcoxon signed rank test, (\alpha=.0167)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Week 1</td>
<td>Week 2</td>
<td>Week 3</td>
</tr>
<tr>
<td>Credibility</td>
<td>16(15;16)</td>
<td>21(20;22)</td>
<td>17(16;19)</td>
</tr>
<tr>
<td>Expectancy</td>
<td>12.4(9.8;13]</td>
<td>15(10.4;16]</td>
<td>15.8(15.8;15.8]</td>
</tr>
</tbody>
</table>

Note: interquartile range (IQR) presented as \((Q1;Q3)\)

Figure 4. Changes in Credibility and Expectancy Questionnaire (CEQ) scores over time (week 1, week 2, week 3). The boxplots present the highest and lowest score, the median and interquartile range as displayed in Table 6. The red line indicates the cut-off score (13.5).
Emotions

Each subscale had a maximum score of 5. The boxplots in Figure 5 show the highest, lowest and median score for each type of exercise along with the interquartile ranges. The red line indicates the cut-off scores which was 2.5 for all exercises. The numbers presented in Figure 5 and Table 7 reveal that the median score of participants’ results were positive in all subscales: ‘alertness’ (>2.5), ‘anger’ (<2.5), ‘anxiety’ (<2.5), ‘sadness’ (<2.5), except a negative score in week 2 on the subscale ‘pleasure’ (<2.5). The statistics presented in Table 7 showed no significant differences over time (p>.05) or between weeks (p>.0167) in pleasure, anger, anxiety, sadness or alertness.

Table 7. Changes in Observed Emotion Rating Scale (OERS) scores over time (week 1, week 2, week 3) and between weeks.

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Median (IQR)</th>
<th>Friedman two-way analysis α=.05</th>
<th>Wilcoxon signed rank test, α=.0167</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleasure</td>
<td>3(3;3)</td>
<td>.305</td>
<td>.083</td>
</tr>
<tr>
<td>Anger</td>
<td>1(1;2)</td>
<td>.223</td>
<td>.317</td>
</tr>
<tr>
<td>Anxiety</td>
<td>1(1;1)</td>
<td>.368</td>
<td>.317</td>
</tr>
<tr>
<td>Sadness</td>
<td>1(1;2)</td>
<td>.223</td>
<td>.317</td>
</tr>
<tr>
<td>Alertness</td>
<td>5(5;5)</td>
<td>.097</td>
<td>.317</td>
</tr>
</tbody>
</table>

Note: interquartile range (IQR) presented as (Q1;Q3)

Figure 5. Changes in Observed Emotion Rating Scale (OERS) scores over time (week 1, week 2, week 3). The boxplots present the highest and lowest score, the median and interquartile range as displayed in Table 7. The red line indicates the cut-off score (2.5).
Discussion

This pilot study examined the feasibility of a video-based exercise program in elderly suffering from dementia, clarified by following three research questions: (1) 'What is the adherence to the exercise program?', (2) 'Is the content of the program and thus the presentation of the exercises suitable in this specific population?', (3) 'What is the motivation, credibility, expectations and emotions of the elderly regarding the program?'.

Reflecting the first research question, results demonstrated moderate to high adherence as all participants finished the program and a mean of 88.9% of the prescribed sessions were completed. Besides the number of individual presences, the participation was lower and individually different, still considered favorable with a mean of 84.11%. The individual differences were remarkable as the oldest participants (>90y) were less willing to participate. Evidence demonstrated the accompaniment of music in physical exercises increase the participation in demented elderly.22 This pilot study confirmed these findings as participants stopped moving or were less attentive when the music dropped or totally disappeared, emphasizing the importance of music as an auditive cue in this program to motivate participation. Coupling visual information, in this case the video, with music could be a supportive component in enhancing the quality of performances as Ghilardi et al. (2000)33 affirm combining auditive cues with visual instructions is essential as evidence indicate the movement accuracy impairs without visual cueing.

In resuming the second research question, quantity and quality of performances were taken into account. As the number of performances stayed the same over all sessions even the difficulty degree increased surmise all type of exercises were well tolerated, excluding the functional exercises presumable by the fact they were exhaustive. At least half of the prescribed number of performances off all exercises per type were completed. So the quantity of functional performances changed significantly, although the quality remained constant over weeks. This is in agreement with the study of Rousseaux et al. (2012)34 demonstrating the fact that imitating meaningful gestures ensure less difficulties. Obvious was the fact that participants practiced difficulties in exercises requiring coordination or balance as the quality of performances were low in static and dynamic exercises, the performances oftentimes not matched the offered instructions. The warming-up exercises changed over time in quality of performances, although results indicated the quality of performances were matching a little with the offered instructions. The presentation of the exercises by a flat screen was well tolerated by the participants, although a larger screen is recommended.

Responding the last research question, this study indicated that the demented participants’ expectations regarding the offered exercises of the program began low in the first week but significantly increased over time. The participants believed the exercises could affect their general functioning, although their credibility regarding the program changed significant over time. Results showed the elderly enjoyed participating the exercise program, they were interested in the program and indicated they endeavored to do their best. Furthermore, they were satisfied with their own performances and they believed their participation was voluntary and not an obligation. Above all, relevant findings were found in that the tension they experienced during the entire program was low. Results with reference to the shown emotions based on the video observations suggested the positive emotions including ‘pleasure’ and ‘alertness’ were positive in that they were observed at least 1 minute in a 10 minute-period. The characteristics included for ‘pleasure’ were less
shown, particular in week 2, this could be misleading as the observations of the emotions for week 2 were only based at data of one session that scored less in general. The negative emotions like ‘anger’, ‘anxiety’, ‘sadness’ were as well positive in that they were not seen during the observation period at the begin and end of each session.

The main finding of this study was that a short-term (3 weeks) training program delivered by a large flat screen for demented elderly (89.6 ± 5.08 years) combining 30 minutes of strength, balance, functional, endurance and flexibility exercises applied in the residents’ nursing home, is considered to be feasible. For the reasons that: moderate to high adherence was demonstrated; exercises were in general well tolerated; all performances, except the exercises demanding many coordination or balance, were of a high quality; the expectations of the participants increased as the program proceeded while the credibility significantly changed; the participants were motivated and showed no negative emotions during the performances of the exercises.

Although this study support the feasibility of an exercise program delivered by a flat screen TV in demented elderly, this study had a few restrictions. Taken into account that this was a pilot study and the recruitment of the intended sample size was successful in that a total of 5 participants were enrolled. This is only a small sample size, and a study with more participants is warranted. Despite the limited power and short period of intervention, significant effects were observed. All 5 participants were diagnosed with Alzheimer’s disease by a specialist, although it was unclear on what criteria or neuropsychological tests this diagnose was based and makes it more difficult to generalize findings with other investigations. As this study was conducted and evaluated only by one assessor, analyses lack control. In optimizing the test-retest reliability of the participants’ answers, the aim was to repeat all questionnaires after 1 hour of time. Due to the fact that the administration of the questionnaires was time consuming, repeating the questionnaires was not possible. The advantage is that the questionnaires were administered after all sessions and individual scores used in analyses were median values of 3 sessions of the same video. The Intrinsic Motivation Inventory is a self-report measure containing 7 subscales, even though only the first subscale ‘interest/enjoyment’ assesses intrinsic motivation as a result these subscale contains more items in comparison with the other subscales. The last limitation was that the imputation technique was applied for missing data due to the fact that participants were absent or not visible on the video recordings. This method keeps the full sample size, although it can yield measurement error. Repeated analyses without missing data imputation were not performed.

The strength of this exercise program was the delivery by a flat screen TV which is often present in nursing homes or other rehabilitation centers. No costly equipment is required and may be a favorable replacement for many expensive rehabilitation devices. As the program is applied as a group activity, it was possible to treat multiple individuals at the same time. The implementation of the program is feasible for staff in that supervising all participants is more evident and easier to carry out, furthermore specific experience in dementia is no requirement for the staff. Another advantage of this study was the included wide range of MMSE scores (11-20) in the included sample. The mean MMSE score and age was 14.4 (SD 3.44) and 89.6 (SD 5.08) respectively and indicated the included participants were old and cognitive low functioning. In comparison with the study of Perilli et al. (2013) where the participants had a mean age of 78 years and a
mean MMSE score of 18 and on the other hand Ghilardi et al. (2000)\textsuperscript{33} who enrolled participants with a mean age of 68.1 (SD 4.7) and an averaged score on the MMSE of 18 (5.03). This high number of age and low number of MMSE score was a benefit in this research.

Concrete structure and exercises are important components for a successful exercise program in demented elderly as investigated in the study of Teri et al. (1998)\textsuperscript{31}. This pilot study has following practical recommendations for exercise programs designed for elderly with dementia and provided by a TV-screen. Considering the structure of the videos it seems important that there was sufficient space between exercises when changing starting position. In this program, the exercises were recorded from a frontal view, in order to provide clear visual instructions a sagittal view could be added by dividing the screen in two parts.

Combining these visual instructions with auditory cues could potential add value to the program. When exercises are joined with music, it is important that it matches the speed of exercises. Considering the intensity Roach et al. (2011)\textsuperscript{32} suggest this is important as well. Remarkable in this study was the fact that participants experienced most difficulties in performing exercises in standing position and exercises focused on upper extremities, they struggled with motor dual tasks likewise activities with crossing the center line.

When external support was left out, activities became more difficult. At least one therapist is recommended in order to supervise exercises performed in standing position without external support. Furthermore, this therapist is necessary seen the participants are not able to remember the appointments and they need to be collected in the gym room. The setting of an exercise program, in this case the gym room of a nursing home seems to be important. In contrast to this setting, a closed space out of distractions or disturbing noises could be more appropriate. As previously mentioned, a 54 inch flat screen was used, given the visual deficits in elderly a larger screen or beamer would suit better in this population. External support during exercises was provided by walking frames with 4 wheels or by chairs, wandering was more noticeable in participants supporting on removable point of support. The size of weights has to be considered as some participants struggled with hand manipulations due to arthrosis. For maintaining safety chairs with armrests were used, however participants used the armrests as support during sitting exercises, in this the quality of the exercise reduced. The administration of the questionnaires was time-consuming, in particular the Intrinsic Motivation Inventory. As investigators can elect the subscales that are relevant in exploring issues of their study and many questions' explorations were similar, a shorter form is perhaps superiorly and can be repeated twice. Moreover, the efficiency of the administration of the questionnaires can be increased by recording it and noting the answers later on.
Conclusion
The 3 weeks during physical exercise program using recorded exercises on video, developed for this study and delivered to residential participants with Alzheimer's disease, was considered to be feasible and emphasizes the potential importance in the modernization of the geriatric rehabilitation. Further studies are needed to confirm these findings and should examine the added value of video-based therapy in addition to the standardized physical therapy.
Reference list


Appendix 1 - Week 1

Warming-up exercises

Exercise 1: marching in sitting position

Exercise 2: boxing in sitting position
Exercise 3: lifting knees in standing position

Exercise 4: clapping hands in standing position

Strength exercises (in sitting position)

Exercise 1: alternately lifting knees

Exercise 2: lifting knees and spreading legs
Exercise 3: alternately extending knees

Exercise 4: feet alternately supporting on tiptoe and heel

Exercise 5: circular movements with spreaded arms
Exercise 6: extending arms forward

Exercise 7: bending arms with weights
Static balance exercises (with external support)

Exercise 1: tandem stand

Exercise 2: spread stand
Exercise 3: lifting knees

Dynamic balance exercise (with external support)

Exercise 1: lunges
Functional exercise

Exercise 1: cycle movements in sitting position

Endurance exercise

Exercise 1: marching with accelerations
Flexibility exercises

Exercise 1: neck muscles

Exercise 2: trunk
Exercise 3A: shoulders

Exercise 3B: shoulders

Exercise 4A: wrists
Exercise 4B: wrists

Exercise 5: calf muscles
Exercise 6A: ankles

Exercise 6B: ankles
Appendix 2 – Instrumental background music

1. Warming-up exercises: Johnny Cash – I walk the line (instrumental)

2. Strength exercises: Johnny Cash – Ring on fire (instrumental)

3. Static balance exercises: Engelbert Humperdinck - Release me (instrumental)

4. Dynamic balance exercises: The platters - The great pretender (instrumental)

5. Functional exercises: Louis Armstrong - When the saints go marching in (instrumental)

6. Endurance exercises: Louis Armstrong - When the saints go marching in (instrumental)

7. Flexibility exercises: Frank Sinatra – Strangers in the night (instrumental)
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Feasibility of an exercise program using video-based training in institutionalized elderly suffering from dementia

Richting: master in de revalidatiewetenschappen en de kinesitherapie-revalidatiewetenschappen en kinesitherapie bij kinderen
Jaar: 2015

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Speetjens, Ite

Datum: 10/06/2015