Process evaluation of the FindMyApps program trial among people with dementia or MCI and their caregivers based on the MRC guidance

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Abstract

Background: People with dementia can improve their wellbeing by using touchscreen technology. FindMyApps is a program comprising of a web-based selection-tool and an errorless learning training to help people with dementia and their caregivers find suitable apps which can improve their self-management and engagement in meaningful activities. This process evaluation was conducted as part of an exploratory pilot trial into FindMyApps and involved a sample of the participants in this trial.

Objective: To evaluate which factors might influence the trial outcomes, according to the Medical Research Council (MRC) guidance. Contextual, implementation, and mechanisms of impact factors that may have influenced trial outcomes were evaluated.

Method: Quantitative and qualitative data were collected from semi-structured interviews (SSIs) with participants from both trial arms and other stakeholders. The SSI designed for this study comprised closed and open questions, based on the MRC process evaluation guidance. Twenty people with mild dementia or Mild Cognitive Impairment (MCI) and their caregivers were recruited in the Netherlands. Exclusion criteria were severe sight problems or moderate to severe dementia. All participants received a tablet computer for three months. Dyads in the experimental group were taught to use the tablet and FindMyApps tool by the 'errorless learning' method, to help them find apps for self-management and meaningful activities. Dyads in the control group received general instruction in tablet use and a list of websites with potentially useful apps.

Results: Important themes identified included participants experiencing technical problems and variable quality of training in the use of the FindMyApps selection-tool. Dyads did not use FindMyApps-tool regularly, but frequently used the apps they found through FindMyApps and experienced them as useful and enjoyable.

Conclusion: The tablet-based FindMyApps intervention is experienced as user-friendly and useful by people with dementia/MCI and their informal caregivers. Several adaptations to the trial protocol are recommended, to ensure robust outcomes of a definitive effectiveness trial of FindMyApps.

Keywords: Dementia, psychosocial interventions, caregiving and interventions, internet-based interventions, mild cognitive impairment (MCI)

INTRODUCTION

Dementia is a syndrome that not only impacts patients, but also their caregivers. It is characterized by deteriorating cognitive functions, such as memory, learning capacity, and language (World Health Organization, 2019). Approximately 50 million people worldwide live with dementia, which is expected to triple by 2050. The majority of people with dementia are and will be, living in the community. Consequently, there is a need for good community care for people with dementia

(Black et al., 2013). Most people with dementia wish to participate in society, stay independent, and live at home for as long as possible (Van der Roest et al., 2009). High quality and affordable community care will also be necessary to meet the increased demand for healthcare and limited availability of long-term care facilities. Interventions to support self-management and involvement in meaningful activities are of major importance for community-dwelling people with dementia and their caregivers. Information Tech-
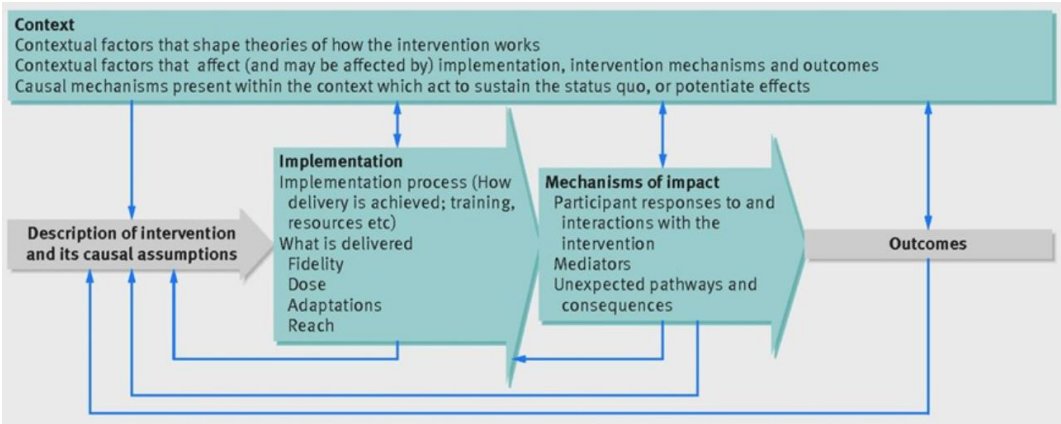
Figure 1. Key factors of the MRC process evaluation guidance (Moore et al., 2015). Shared under the terms of CC BY-NC 4.0 License (https://creativecommons.org/licenses/by-nc/4.0/).

nology (IT) applications may be useful in providing such support (Meiland et al., 2012, 2017).

Older people with dementia rarely use IT applications as they often do not meet their capacities and needs (Lim, Wallace, Luszcz, & Reynolds, 2013). However, it has been shown that the well-being of people with dementia can improve by using touchscreen technology (Tyack & Camic, 2017), which they can also use independently (Joddrell & Astell, 2016). Few apps have been specifically developed for people with dementia (Øksnebjerg, Janbek, Woods, & Waldemar, 2019), yet a growing supply of tablet-based apps exists that can help people with cognitive problems to manage their lives and to engage in meaningful activities. For instance, apps that send reminders to take medication and creative apps. It has been shown that people with dementia experience playing casual games on a tablet as a pleasant and meaningful activity (Groenewoud et al.,

Figure 2. Start screen of the FindMyApps app with the three main categories: 'in and around the house' (daily activities and health), 'contacts' (contact at a distance and help with communicating) and 'leisure time' (sports, hobbies and nature).

2017) and that touchscreen-based art could improve their well-being (Tyack, Camic, Heron, & Hulbert, 2017). Involving people with dementia in all stages of IT development may have empowering effects (Span, Hettinga, Vernooij-Dassen, Eefsting, & Smits, 2013; Suijkerbuijk et al., 2019). Inclusion can occur during inventory of user-requirements (i); setting technical requirements and prototyping (ii); pilot-testing (iii); and measuring effects (iv) (Campbell et al., 2000). Over the last decade, people with dementia have been increasingly involved in development of technology (Meiland et al., 2017).

FindMyApps is an interactive web application designed for and in collaboration with people with dementia and their informal caregivers (Kerkhof et al., 2017, 2020, 2019). It consists of training to learn to use a hand-held touchscreen device (tablet) and an online tool that helps people find suitable apps for self-management and meaningful activities (Kerkhof et al., 2019). In this study, meaningful activities include daily, social and pleasurable activities, in accordance with the dimensions of social health described by Dröes et al. (2017). FindMyApps is designed to suggest apps to users, on the basis of their user profile. User profiles are created from users' self-reported needs and abilities. Following the Medical Research Council (MRC) guidance for design and evaluation of complex interventions (Craig et al., 2008; Kerkhof et al., 2017, 2019) we conducted two user-participatory development studies, followed by a first exploratory pilot trial (Kerkhof et al., 2020).

In the current study, which was part of the Interdisciplinary Network for Dementia Using Current Technology (INDUCT) project, the FindMyApps program was compared to normal tablet use by people with mild dementia and their informal caregivers. The results of the explorative effect evaluation are in preparation for publication.
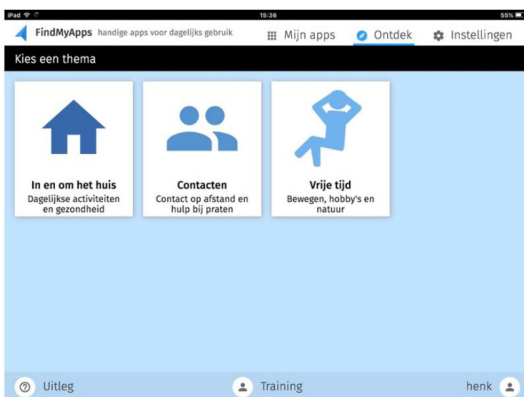
Table 1. Characteristics of persons with dementia and informal caregivers participating in the semi-structured interviews, at the start of the feasibility study.

Persons with dementia/MCI	Experimental group (n=10)	Control group (n=10)	Difference test	p
Sex, n			$Chi^2 = .48$	.361
Female	3	5		
Male	7	5		
Age, M (SD), [min-max]	72.70 (9.129), [62-92]	67.70 (8.932), [53-81]	U = 36.5 Z = -1.02	.307
Type of dementia, n			$Chi^2 = 2.40$	.663
Alzheimer's disease	4	6		
Vascular dementia	2	1		
Frontotemporal	1	-		
Other	2	1		
MCI, n	1	2		
Severity of cognitive impairment (BCRS/GDS) [1-7], n			$Chi^2 = .29$	.865
2. Very mild cognitive decline	3	2		
3. Mild cognitive impairment	5	6		
4. Mild dementia	2	2		
Awareness (GRAD score), n			$Chi^2 = 2.69$	0.442
Intact	1	3		
Mildly impaired	1	1		
Moderately impaired	-	-		
Severely impaired	-	1		
No response	8	5		
Education level, n			$Chi^2 = 3.01$	.669
Primary education	-	-		
Secondary education (vocational)	2	2		
Secondary education (academic)	-	1		
Further education (vocational)	3	4		
Higher education (vocational)	3	2		
Higher education (academic)	2	1		
Use of tablet at start of the study, n			$Chi^2 = 3.33$	.504
Every day	1	3		
Once a week	1	-		
Once or twice every month	-	1		
Once in my life	1	1		
Never used	7	5		

FindMyApps is a complex intervention: whether users experience the desired beneficial effects depends on multiple factors during the implementation and execution of the intervention. In designing this process evaluation, we followed the UK Medical Research Council Guidance on Process Evaluation of Complex Interventions, which is an internationally recognized standard (Moore et al., 2015). Key components of this guidance are con-text, implementation and mechanisms of impact (Figure 1). For the purposes of this study, 'mechanisms of impact' was subdivided by the researchers into three categories: usability, learnability, and adoption. Usability was further subdivided into effectiveness, efficiency and user satisfaction, according to ISO9241 definitions (International Organization for Standardization, 2018). In this process evaluation we aimed to evaluate how us-

Table 1 (cont.). Characteristics of persons with dementia and informal caregivers participating in the semi-structured interviews, at the start of the feasibility study.

Caregivers	Experimental group (*n*=10)	Control group (*n*=10)	Difference test	*p*
Sex, *n*			Chi^2 = .95	.329
Female	8	6		
Male	2	4		
Age, *M(SD)*, [min-max]	65.80 (8.522), [55-81]	62.70 (10.761), [42-75]	U = 41.0 Z = -.607	.544
Relationship with person with dementia, *n*			Chi^2 = 3.06	.217
Partner	9	8		
Child	-	2		
Professional caregiver	1	-		
Education level, *n*			Chi^2 = .53	.970
Primary education	-	-		
Secondary education (vocational)	1	2		
Secondary education (pre-academic)	2	2		
Further education (vocational)	3	3		
Higher education (vocational)	3	2		
Higher education (academic)	1	1		
Living situation, n			Chi^2 = 3.60	.165
Cohabiting with the person with dementia/MCI	7	3		
Living alone	1	1		
Living together with partner and possibly children	2	6		
Use of tablet, *n*			Chi^2 = 1.14	.767
Every day	3	4		
Once a week	1	1		
Once or twice a month	-	-		
Once in my life	1	-		
Never used	5	5		

Note: Between-group differences were tested using Pearson chi-square test for categorical/nominal variables, and Mann-Whitney *U* test for ordinal and continuous/interval variables. MCI = Mild Cognitive Impairment; BCRS = Brief Cognitive Rating Scale; GDS= Global Deterioration Scale; GRAD= Guidelines Rating of Awareness in Dementia.

ers of the FindMyApps program experienced its usability, and learnability and participants' adoption of FindMyApps, compared to those who used a tablet without the FindMyApps selection tool. Secondly, we intended to identify contextual or implementation factors that may have influenced the trial outcomes.

The following research questions were addressed via this process evaluation:
• What are the conditions for successful implementation and dissemination of the touchscreen technology FindMyApps?

• Which contextual, implementation, and mechanism of impact factors influenced use of the tablet and FindMyApps (and potentially affected the outcomes) during the pilot trial of the FindMyApps program?
• What modifications to the trial protocol may be necessary to ensure robust outcomes of a definitive (cost-)effectiveness trial?

METHODS
Design
For this process evaluation study quantitative and qualitative data were collected.

Table 2. Overview of questions related to contextual factors and answers of the person with dementia/MCI (pwd) and caregiver (cg) in the experimental (exp) and control group (cont). FMA = FindMyApps.

Contextual factors	Exp (n=10), n	Cont (n=10), n
1. Do you think that touchscreen devices can be useful for people with memory problems? (pwd)		
Very useful	2	-
Useful	3	-
A little useful	-	8
Not useful	2	1
Don't know	-	1
No response	3	-
2. Did your beloved experience any problems with the internet connection? (cg)		
Never	8	9
Sometimes	1	1
Often	1	-
Always	-	-
3. Or with the tablet itself (e.g. forgot to charge)? (cg)		
Never	9	8
Sometimes	1	1
Often	-	1
Always	-	-
4. Did material, social or financial factors influence the use of FMA or the choice of certain apps?		
Yes	3	2
No	7	8

For the pilot trial of the FindMyApps program in which the process evaluation was conducted, participants were randomly assigned to the experimental or control group, after stratification by (i) diagnosis (dementia or MCI) and (ii) cohabiting with a caregiver. In the experimental group, participants received a tablet with the FindMyApps selection tool and training in use of the tablet and the tool. Participants in the control group received basic instructions in tablet use and links to websites with usable apps for people with dementia. Study data were collected via completion of a battery of questionnaires by participants at baseline (T0) and after three months with the intervention (T1).

For the process evaluation a purposively selected sample of participants with varying background characteristics including living situation (cohabiting with a caregiver or not), both from the experimental and the control group, was invited to take part in a semi-structured interview (SSI). The interview consisted of three types of questions: Open questions; closed questions with ordinal answers (Likert scales); and questions with the option to provide both an ordinal answer and a further elaboration on the ordinal answer.

The study was approved and declared exempt from the Medical Research Involving Human Subjects Act by the medical ethical committee of the VU University medical center (VUmc) (registration number: 2017.401).

Participants and setting
From September 2018 until December 2019 participant dyads (person with diagnosed mild dementia/MCI and their informal caregiver) were recruited in the Netherlands. Potential participants were approached in Alzheimer Cafés, the Alzheimer Center and Center for Elderly Care Medicine of VUmc, Meeting Centers for people with dementia, via relevant Facebook groups, the FindMyApps project website, and the website of Alzheimer Nederland. People with dementia/MCI were included if they cohabited with their caregiver or were visited by them at least twice a week. People were excluded if they had severe eyesight problems or moderate to severe dementia (MMSE<18; GDS5-7).

Intervention
Experimental group
FindMyApps consists of a personalized selection tool for finding suitable apps, and training in how to use the selection tool, tablet, and apps. The training is based on the 'errorless leaning method'. FindMyApps is a web application designed for tablet computers running Android and iOS operating systems. The application's function is to support users in selecting tablet-based apps that meet the user's personal needs, interests, and abilities. The tool is meant to be used by persons with dementia, supported by their caregiver (Kerkhof et al., 2019).

The core content of the FindMyApps tool is an app library: a database containing approximately 180 apps, focused on self-management and meaningful activities for people with dementia. All of the apps in the database have been assessed on criteria for determining usability by people with dementia. The criteria used to assess apps are based on research conducted with people with dementia and their caregivers (Kerkhof, Graff, Bergsma, De Vocht, & Dröes, 2016). Apps that sufficiently meet these criteria are included in the database.

The user interface through which users access the database allows them to create a user profile, search for apps, and review instructions in use of the tablet and the FindMyApps app selection tool. Users create a profile by specifying prefer-

Table 3. Overview of questions related to implementation factors and answers of the person with dementia/MCI (pwd) and caregiver (cg) in the experimental (exp) and control group (cont). FMA = FindMyApps.

Implementation	Exp (n=10), n	Cont (n=10), n
1. Do you feel you received the support you needed for using the tablet (/FMA) from your caregiver? (pwd)		
Totally disagree	1	-
Somewhat disagree	-	-
Neither agree nor disagree	-	3
Somewhat agree	-	1
Totally agree	7	5
Didn't need this	1	1
No response	1	-
2. How did you experience the support from your caregiver? (pwd)		
Very helpful	5	2
Helpful	2	6
A little helpful	-	1
Not helpful	1	-
Didn't need this	1	1
No response	1	-
3. Was the training on how to use the tablet (/FMA) clear enough? (cg)		
Yes	8	3
No	2	3
No response	-	4
4. Could you deliver the training to your beloved one according to the errorless learning method that was used in the training? (cg)		
Yes	7	N.A.
No	3	
5. Did you use the helpdesk? (cg)		
No	10	10

In the experimental group, each dyad was taught how to use the tablet and the FindMyApps tool and was provided with a written manual. This included basic functions, such as switching the tablet on and off, and more complex functions such as downloading apps. Caregivers received tips to support the person with dementia/MCI and were instructed on how to apply the errorless learning method (De Werd, Boelen, Olde Rikkert, & Kessels, 2013). This is a method to teach people with cognitive impairments instrumental skills, by breaking an activity down into small steps. Participants are encouraged not to make guesses about how to perform an activity, and when they make errors, these are immediately corrected. The aim is to prevent the learning of errors (Clare & Jones, 2008). The method has been reported as more effective than other pedagogical methods in teaching people with cognitive impairment new skills (Bourgeois et al., 2014; Dechamps et al., 2011; Thivierge, Jean, & Simard, 2014). Caregivers were taught this method as a means for them to effectively teach the person with dementia/MCI to use the FindMyApps selection tool, the tablet, and apps during the three-month intervention period.

As part of the training two demonstration videos were shown, explaining functions of the tablet and FindMyApps respectively. Videos remained available to participants via the FindMyApps tool. Participants in both groups received follow-up phone calls after two and six weeks to check for technical problems. All participants could consult a telephone helpdesk.

ences for features of apps that meet their needs and abilities through binary (yes/no) responses to six options, such as '*Do you want apps with large text size?*' When searching for apps, available apps are divided into three main categories: '*in and around the house*' (with sub-categories daily activities and health), '*contacts*' (contact at a distance and help with communicating), and '*leisure time*' (sports, hobbies, and nature) (*Figure 2*). Within each sub-category is a list of apps. For every app, there is an information page, displaying a short description and a score showing the extent to which the app matches the user's preferences on a scale from one to ten: ten representing the best match. Each page contains a link to the Google Play Store (Android) or Apple App Store (iOS) where users can download the app.

An overview of applications that have previously been viewed by the user in the Google Play Store or Apple App Store is shown on a separate page ('*MyApps*'). Each page within the FindMyApps application has an explanatory help function.

Control group
In the control group, dyads did not receive the FindMyApps selection tool and errorless learning training. They received training in general tablet-use, not based on any particular pedagogical method. They viewed a video demonstrating basic functions of the tablet and also received a written manual with the same information, including suggestions for websites where they could find apps that might be useful for people with dementia. References to websites were kept up to date throughout the study.

Instruments
Participant characteristics were assessed via a questionnaire filled in by the caregiver (*Table 1*). The Guidelines for the Rating of Awareness Defi-

Table 4. Overview of questions related to mechanisms of impact (usability (effectiveness, efficiency, user satisfaction), learnability and adoption) and answers of the person with dementia/MCI (pwd) and caregiver (cg) in the experimental (exp) and control group (cont). FMA = FindMyApps.

Mechanisms of impact	Exp (n=10), n	Cont (n=10), n
Usability		
1. Did you download apps (via FMA)? (with or without the help of your caregiver)		
Yes	5	7
No	4	3
No response	1	-
Effectiveness		
2. Could you find apps that meet your personal interest/needs? (pwd)		
Yes	7	6
No	2	1
No response	1	3
3. If yes, how many? (pwd)		
1-2	2	2
3-4	3	1
>5	2	2
No response	3	5
4. If yes, in which area did the apps that you have used help you the most? (pwd)		
Self-management	1	2
Meaningful activities	3	3
Social contacts	1	-
Other, such as relaxation and brain training	5	3
No response	-	2

(which is reported elsewhere). Questions regarding contextual factors were related to the personal background of participants, for instance '*Did you have experience using a tablet?*' and to their material, social and financial environment. Implementation was defined as what is delivered to the study participants by the researchers and what is delivered by the informal caregiver within the dyad as part of the intervention, an example question was '*Do you feel like you received the support you needed from your caregiver?*' Mechanisms of impact consisted of usability, learnability, and adoption. Usability was defined as '*the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction*' (International Organization for Standardization, 2018). An example question for usability was '*How difficult was it to find a preferred app in FindMyApps and why?*' Learnability was defined as how easy or difficult it was for participants to learn how to use the tablet and/or FindMyApps, for instance '*How was learning how to use FindMyApps?*' Adoption questions were related to use of the tablet and/or FindMyApps in the final month of the study and intention to continue using the intervention, for instance '*Does FindMyApps form part of your daily activities?*'

cits (GRAD) (Verhey, Rozendaal, Ponds, & Jolles, 1993) and Brief Cognitive Rating Scale (BCRS) (Reisberg, Ferris, De Leon, & Crook, 1982) were conducted at baseline to determine self-awareness of cognitive deficits and severity of cognitive decline, respectively.

Semi-structured interviews
The process evaluation was focused on evaluation of the feasibility of the intervention and research protocol by using SSIs with persons with dementia/MCI, caregivers, and with stakeholders (key figures in the implementation), which were tested in a first pilot (Kerkhof et al., 2020). The interviews with participants included questions specifically asked the person with dementia/MCI, and questions specifically asked the caregiver. However, as the caregivers were present when the person with dementia/MCI was interviewed, they sometimes joined the conversation and helped the person with dementia/MCI to remember or express their experiences with the intervention when answering questions. The SSIs were used mainly to collect qualitative information regarding contextual, implementation, and mechanisms of impact factors, both in the experimental and control group, which might have influenced the outcome of the effect evaluation

Procedure
Dyads were informed on the study by written information which they received by email or in person. Dyads interested in participating were further informed about the study by one of the researchers. All eligible participants provided written informed consent to participate in the trial and the process evaluation. The participants' characteristics were collected from the informal caregiver through an online questionnaire.

After the three-month intervention period, dyads purposively selected to participate in SSIs for the process evaluation were visited at home by an interviewer (students clinical, neuro, and applied psychology and nursing). All selected participants agreed to be interviewed. Interviewers were independent of the study and had received training in conducting SSIs and in communicat-

Table 4 (cont.). Overview of questions related to mechanisms of impact (usability (effectiveness, efficiency, user satisfaction), learnability and adoption) and answers of the person with dementia/MCI (pwd) and caregiver (cg) in the experimental (exp) and control group (cont). FMA = FindMyApps.

Mechanisms of impact	Exp (n=10), n	Cont (n=10), n
Effectiveness		
5. How useful were the following features of FMA: (pwd)		
The personal settings		N.A.
Very useful	-	N.A.
Useful	6	N.A.
A little useful	1	N.A.
Not useful	-	N.A.
Don't know/Didn't use	2	N.A.
No response	1	N.A.
The 'My Apps' page		N.A.
Very useful	-	N.A.
Useful	6	N.A.
A little useful	-	N.A.
Not useful	-	N.A.
Don't know/Didn't use	3	N.A.
No response	1	N.A.
The explanation button		N.A.
Very useful	-	N.A.
Useful	3	N.A.
A little useful	1	N.A.
Not useful	-	N.A.
Don't know/Didn't use	5	N.A.
No response	1	N.A.
6. Did you feel the need to search for other apps somewhere else? (pwd)		
Yes	4	N.A.
No	5	N.A.
No response	1	N.A.
7. If yes, how many useful apps did you find elsewhere? (pwd)		
>5	4	N.A.
No response	6	N.A.
8. If yes, in which area did these apps help you the most? (pwd)		
Self-management	1	N.A.
Meaningful activities	3	N.A.
Social contacts	1	N.A.
No response	5	N.A.

ing with people with dementia. Interviewers recorded participants' answers to questions, other remarks, and important contextual information in writing and subsequently entered data into an electronic database via the Castor Electronic Data Capture web application.

Stakeholders involved in the trial were also interviewed: one of the researchers managing the trial; one of the SSI interviewers who also de-livered training to participants; and an employee of the app development company. Questions regarding stakeholders' perspectives complemented questions asked of participants, for example, *"What problems occurred that inhibited the use of FindMyApps for participants?"*

Data analysis

Data regarding participants' background characteristics were analyzed by descriptive statistics (means, standard deviations) using SPSS 24.0. Differences between experimental and control groups were tested using the Mann-Whitney U test and Pearson Chi-Square Tests. The data from the closed questions of the SSIs were summarized descriptively (numbers for reply categories) in tables. As many of these (context/intervention related) questions differed between the experimental and control groups, no between groups statistical difference tests were performed.

Data from open questions from SSIs were analyzed according to the 'consolidated criteria for reporting qualitative research' (COREQ) framework (Tong, Sainsbury, & Craig, 2018), by thematic analysis. Answers were coded according to the key factors and sub-themes derived from the MRC process evaluation guidance by couples of senior (TE, RD) and junior researchers (KB, DN) independently. Coding discrepancies were discussed until consensus was reached. The most important findings were summarized, with illustrative quotations, which are reported in this article, as translated from the original Dutch by a bilingual researcher (DN).

RESULTS
Study population
Of 56 dyads participating in the pilot trial of the FindMyApps program, 20 participated in SSIs (10 experimental groups, 10 control groups). No significant differences in background charac-

Table 4 (cont.). Overview of questions related to mechanisms of impact (usability (effectiveness, efficiency, user satisfaction), learnability and adoption) and answers of the person with dementia/MCI (pwd) and caregiver (cg) in the experimental (exp) and control group (cont). FMA = FindMyApps.

Mechanisms of impact	Exp (n=10), n	Cont (n=10), n
Effectiveness		
9. Was your beloved able to download apps independently? (cg)		
Yes	4	2
No	6	5
No response	-	3
Efficiency		
10. How easy or difficult was it to find a preferred app (within FMA)? (pwd)		
Difficult	2	3
Somewhat difficult	3	1
Easy	2	2
Very easy	1	-
No response	2	4
11. Could you use the apps you have downloaded easily? (pwd)		
Never	-	-
Sometimes	1	4
Often	3	1
Always	1	-
No response	5	5
User satisfaction		
12. How was it to operate within FMA in terms of sensitivity of the touchscreen? (pwd)		
Difficult	2	N.A.
Somewhat difficult	2	N.A.
Easy	2	N.A.
Very easy	3	N.A.
No response	1	N.A.
13. Did you manage to start and view the training videos? (pwd)		
Yes	1	N.A.
No	-	N.A.
Didn't try	8	N.A.
No response	1	N.A.

group (*Table 1*). Half of all caregivers had previous experience with tablet use. Most people never or sometimes had problems with their internet connection or with the tablet (*Table 2*, item 2). Of 17 participants who answered this question, 13 felt that touchscreen devices can be at least a little useful for people with memory problems. Most participants reported no <u>material, social, or financial factors</u> that influenced their choice of apps or the use of tablet-based apps.

Qualitative analysis
The majority of comments about contextual factors were neutral or positive statements. For instance, participants commented that they had previous <u>experience</u> in using tablets and/or smartphones, which they felt relevant to their experience with the intervention. As an example, caregiver 26 (control group) said: *"[He] already had a smartphone so [he] was already familiar with technology."* Comments coded as negative generally referred to a pre-existing aversion to technology of the participant in the eyes of the informal caregiver, such as *"[My partner has an] aversion to tablets."* – [Caregiver 1, experimental group].

The interviewers reported that remembering a password to use the app or the tablet was difficult. Some suggested that the app should be usable without a password. The web development company said that users sometimes experienced slow internet connections which affected app use; this was usually related to Wi-Fi connections rather than the FindMyApps selection tool itself.

teristics were found between groups (*Table 1*). Interviews with caregivers lasted 5-30 minutes, whereas interviews with people with dementia/MCI took 10-50 minutes. A full list of the results from the closed questions in the interview can be requested from the authors. Below the contextual, implementation, and mechanisms of impact factors (and themes <u>underlined</u>) that may have influenced the use and impact of FindMyApps and the tablet are described.

Contextual factors
Quantitative analysis
Three people with dementia/MCI in the experimental group had <u>experience</u> with using a tablet, compared to five participants in the control

Implementation
Quantitative analysis
Most persons with dementia/MCI who felt they needed support from their caregiver to use the tablet and/or FindMyApps selection tool, <u>appreciated the support</u> and found it helpful (*Table 3*, items 1 & 2). Most caregivers in the experimental group reported that they were able to teach the person with dementia according to the <u>errorless learning method</u>. Relatively more participants from the experimental group (80%) than

Table 4 (cont.). Overview of questions related to mechanisms of impact (usability (effectiveness, efficiency, user satisfaction), learnability and adoption) and answers of the person with dementia/MCI (pwd) and caregiver (cg) in the experimental (exp) and control group (cont). FMA = FindMyApps.

Mechanisms of impact	Exp (n=10), n	Cont (n=10), n
Learnability		
14. How was learning how to use FMA? (pwd)		
Difficult	1	N.A.
Somewhat difficult	3	N.A.
Easy	3	N.A.
Very Easy	1	N.A.
No response	2	N.A.
15. How was learning how to use the tablet? (pwd)		
Difficult	3	2
Somewhat difficult	1	4
Easy	2	4
Very easy	2	-
No response	2	-
16. How difficult was learning to use the downloaded apps? (pwd)		
Difficult	1	1
Somewhat difficult	2	5
Easy	5	1
Very easy	-	-
No response	2	3
17. Did the training videos facilitate learning how to use the tablet (and FMA?) (pwd)		
Yes	-	1
No	-	2
Didn't try	9	6
No response	1	1
18. Has the training helped you to support your beloved in use of (FMA and) the tablet? (cg)		
Yes	3	1
Sometimes	1	1
No	6	3
Didn't try	-	3
No response	-	2

from the control group (50%) rated the training provided as part of the intervention (tablet and FindMyApps training or basic tablet training only respectively) enough.

Qualitative analysis
Several dyads in the experimental group experienced technological problems, such as old operating systems or having trouble downloading apps. Some dyads mentioned that the training had been insufficient. One caregiver suggested training should be adapted to the participant's specific diagnosis [caregiver 1, experimental group]. Some caregivers felt confronted by impatience in the person with dementia/MCI. Other caregivers enjoyed helping the person

with dementia/MCI. In the control group, some persons with dementia/MCI said that their caregiver downloaded apps for them as they were unable to do this themselves. Reactions to the instruction about how to use the tablet were mixed: "*Short, but clear*" [caregiver 3, control group], whilst another dyad reported that no instruction was given at all [person with dementia/MCI 2, experimental group].

The interviewers reported that it was sometimes unclear for participants what they should do with the tablet, especially in the control group. Participants also told interviewers they didn't receive training and didn't know that a '*helpdesk*' existed, although they knew that they could phone for assistance. Some participants stated that they experienced it as difficult to use a different operating system (Android or iOS) than they were used to, and some commented that certain apps in FindMyApps were unavailable for download.

From the stakeholder interviews, the web development company noted that the services in the data center sometimes had connection problems resulting in the web application being temporarily offline.

Mechanisms of impact
Usability
Quantitative analysis: Most participants downloaded apps during the research period, both in the experimental and control group (*Table 4*, item 1).

Qualitative analysis: Some qualitative responses about the usability of FindMyApps were positive: "*Very intuitive…very user friendly*" [caregiver 1]. Other responses were negative: "*Difficult, we can do little with FindMyApps. [We] just use [our] telephone or laptop*" [caregiver 4]. In the control group, several people responded positively or neutral to working with the tablet. Some respondents made remarks of disappointment about the pricing of the apps or in-app advertising.

Table 4 (cont.). Overview of questions related to mechanisms of impact (usability (effectiveness, efficiency, user satisfaction), learnability and adoption) and answers of the person with dementia/MCI (pwd) and caregiver (cg) in the experimental (exp) and control group (cont). FMA = FindMyApps.

Mechanisms of impact	Exp (n=10), n	Cont (n=10), n
Learnability		
19. Could your beloved use FMA independently? (cg)		
Difficult	5	N.A.
Somewhat difficult	-	N.A.
Easy	5	N.A.
Very easy	-	N.A.
20. Could your beloved use the tablet independently? (cg)		
Difficult	3	4
Somewhat difficult	2	4
Easy	2	-
Very easy	3	1
No response	-	1
Adoption		
21. Does the use of the apps form part of your daily activities? (pwd)		
Not at all	2	-
Somewhat	3	3
Often	3	4
Very often	1	-
No response	1	3

the experimental and control group, people with dementia/MCI said they didn't experience using apps as 'functionally supportive' or 'life-changing' but rather as joyful or useful. Some caregivers in the experimental group found the tool helpful and easy to use, others give no opinion.

Efficiency

Quantitative analysis: Most persons with dementia/MCI in both groups found it difficult to find a preferred app (Table 4, item 10). However, a relatively larger proportion of people in the experimental group reported they could use downloaded apps easily. The majority of caregivers reported that the person with dementia/MCI was unable to download apps independently (Table 4, item 9).

Qualitative analysis: Caregivers felt it was necessary to help the person with dementia search for and download apps. "Searching independently [for apps] was not possible" [caregiver 19, experimental group]. "She [caregiver] has to help me. I couldn't do it myself." [person with dementia/MCI 28, experimental group]. Some caregivers suggested FindMyApps could be used more efficiently by, for example, introducing fewer (sub)categories or improving the functionality of the 'MyApps' page.

User satisfaction

Quantitative analysis: The ease of using FindMyApps was scored six out of ten by persons with dementia/MCI (N=9) and seven by their caregivers (N=10). Both groups answered the question 'What grade would you give FindMyApps?' with a seven on average. Most participants in the experimental group didn't try to view the training videos and satisfaction with this feature could therefore not be assessed.

Qualitative analysis: Not all people were satisfied with the touchscreen, which was apparent in both quantitative and qualitative analysis. Some thought it was quite small, others used a stylus pen because accurate touching was difficult. Some were frustrated because navigation was difficult because they couldn't find the 'Back' button, for example. People in the control group mentioned that there were big differences in the quality of apps they used and not all were user-friendly. Some people in both groups

Effectiveness

Quantitative analysis: Most people found apps meeting their personal interests/needs (Table 4, item 2). The majority of them found at least three apps that helped them, mostly in the area of meaningful activities (e.g. cognitive stimulation and physical activities). Some respondents in the experimental group felt the need to search for apps somewhere else, these people all found more than five useful apps that helped them in the area of meaningful activities. The usefulness of FindMyApps was scored six out of ten by the persons with dementia/MCI (N=9), and seven by their caregivers (N=10). Of the features in FindMyApps, the personal settings and the 'MyApps' page were rated useful by most people, whereas most people either didn't use or had no opinion about the explanation button.

Qualitative analysis: People in the experimental group found several apps via FindMyApps they considered useful and enjoyed, such as apps for games, music, creative artwork, and memories. "We spent whole evenings with music playing, singing along with old songs from the past via the 'dementie en herinneringen app' (dementia and memories app)]." [person with dementia/MCI 28, experimental group]. People in the control group mentioned several apps they enjoyed or found useful, such as apps for memory training, relaxation, reminiscence, puzzles, and games. Both in

were positive about crosswords, memory training, films, and music from the past: "*Very nice and helpful. Things from the past about the Jordaan (neighborhood of Amsterdam) and games, which he can win!*" [Caregiver 37, control group].

Learnability
Quantitative analysis: In the experimental group, some persons with dementia/MCI found the tablet and the FindMyApps selection tool difficult to learn, some found it easy (*Table 4*, item 14). In the control group, relatively more participants experienced learning to use the tablet as difficult. To the question "*How difficult was learning to use the downloaded apps?*" most people from the experimental group said it was easy compared to only one person in the control group. Of 18 respondents 15 said they didn't use the training video, one said the <u>training video facilitated learning</u> how to use the tablet. A small number of people reported that the <u>tablet (and FindMyApps)</u> training helped to support the person with dementia/MCI. Many participants (especially in the control group) mentioned they didn't receive any training. Half of those interviewed from the experimental group reported that it was difficult for the person with dementia/MCI to use FindMyApps independently and half said it was easy. As for the tablet, most people in the control group experienced it as difficult to learn compared with half of those interviewed from the experimental group.

Qualitative analysis: Participants from the control group tended to describe difficulties at first, which in some cases resolved with time and practice. Negative comments, in both experimental and control groups, frequently referred to a lack of concentration, motivation, and patience of participants as a barrier to practicing and learning: "*It takes a lot of effort to learn and [the participant] didn't have patience for that.*" – [Person with dementia/MCI 28, experimental group].

Adoption
Quantitative analysis: After three months the use of apps formed <u>a part of their daily activities</u> for most participants (*Table 4*, item 21).

Qualitative analysis: However, eight responded '*no*' to the question '*Do you think that your life or the life of your loved one has changed since you began using FindMyApps?*'. Nonetheless, there were users who also expressed disappointment that the FindMyApps app was not already available in the app store, because they used the tablet on a frequent basis and wanted to continue. In the control group, some participants expressed that by the end of the study they enjoyed using the tablet.

Interviewers felt that adoption was more likely if the caregiver was cohabiting with the person with dementia/MCI. It was also noted by interviewers that some participants were unable to use the tablet; usually, because the person with dementia/MCI wasn't motivated to learn it. The app development company reported that some user experience issues occurred in relation to new tablets: one of the challenges is that when updated operating systems are published some features are added or changed, making the web application react differently than planned, which then had to be updated as well.

Additional comment
Some participants reported that the interviews took too much time, with respect to both the questionnaire-based interviews and the SSIs (*Table 4*).

DISCUSSION
Overall results
The aim of this process evaluation was to trace contextual, implementation, and mechanism of impact factors that may influence the outcomes of FindMyApps pilot trial. Quantitative and qualitative data were analyzed. Findings regarding contextual factors were that people sometimes experienced technical problems, such as apps being unavailable and FindMyApps being temporarily offline. This was confirmed by quantitative results and the literature, which shows that it is important to solve technical issues before formally evaluating such interventions (Beentjes, 2019). As for influencing factors related to implementation, some participants noted that the training was insufficient. Nevertheless, the support of people with dementia/MCI by the caregivers and the errorless learning method (De Werd et al., 2013) were generally rated as helpful. In addition, quantitative and qualitative results showed that persons with dementia/MCI needed help downloading apps, which was expected based on previous studies (Kerkhof et al., 2019). With respect to mechanisms of impact, although dyads reported that they did not use FindMyApps regularly, they did use the apps they found through FindMyApps regularly. When these apps were downloaded, FindMyApps was not used for a while until there was a wish to find new apps. This suggests that FindMyApps may be a useful tool to find apps, confirming previous findings (Kerkhof et al., 2020). The frequency of use of FindMyApps may increase if the app library is regularly updated. Regarding learnability, it was found to be important that participants were motivated to learn how to use a tablet, as this made it easier for them to learn to use the tablet and FindMyApps. This is in line with earlier findings, which showed that consideration of individual needs and interests facilitates adoption of eHealth interventions by people with dementia

(Hattink, Dröes, Sikkes, Oostra, & Lemstra, 2016; Imbeault, Langlois, Bocti, Gagnon, & Bier, 2018; Koo & Vizer, 2019).

Notably, the first few dyads included gave more negative comments; this could be explained by implementation problems such as technical problems at the start of the study period. Early in the study, the planned implementation procedure was insufficiently executed: not all participants systematically received training and follow-up calls as prescribed. The videos were not always shown during the training, probably because some people already had experience in using the tablet, which might also explain the small number of people who watched them subsequently.

Strengths and limitations

Quantitative and qualitative data were collected and, where possible, compared, and related to the literature. In addition to people with dementia/MCI and their caregivers, other stakeholders provided insights into factors that influenced the use of FindMyApps. The user-participatory involvement of people with dementia/MCI in this exploratory trial phase was also a strength (Meiland et al., 2012). Moreover, the semi-structured nature of interviews can be a strength in studies with people with dementia/MCI who may struggle to provide answers to open questions. However, some participants experienced the questionnaires as too long, sometimes repeating similar questions regarding the tablet and the FindMyApps app. Therefore, the later questions in the experimental group might have been less comprehensively or reliably answered. Only a sample of participants in the feasibility study was interviewed for this process evaluation. Their answers might not represent the entire group.

Recommendations definitive trial

The SSIs were not audio-recorded, which made it difficult to collect fully detailed answers. For the definitive trial it might be helpful to audio-record interviews or to have one researcher interviewing and a second researcher writing down all comments made by the interviewee. Furthermore, the training of participants has to be delivered consistently by every researcher/interviewer. It is important to show the training videos during the training, which was not always done during this pilot resulting in the videos hardly being used later on. This may have adversely impacted learning to use the tablet and FindMyApps and may have resulted in less and/or less effective use. It was reported that the helpdesk was not used, but people did use the general phone number of the main researcher (i.e. the helpdesk) or emailed in case of questions. Therefore, it is recommended to better explain the helpdesk function and contact details to participants, so that they can use it if needed. As some participants reported difficulty using an unfamiliar operating system (Android/iOS), it is recommended to provide participants with a tablet matching their preferred operating system where possible. People who received the follow-up calls were more certain about their opinions over the functions of FindMyApps, suggesting that it is important to make these calls as prescribed by the protocol.

Scientific and practical relevance

The findings of this study are relevant to the growing field of technological interventions for people with dementia/MCI and their caregivers. Participants in this study showed an interest in FindMyApps and the use of tablet-based apps to enhance their self-management and participation in meaningful activities. This process evaluation provides important feedback from the intervention target group, providing further evidence that the involvement of people with dementia/MCI is important in the development and evaluation of eHealth interventions (Kenigsberg et al., 2019; Kerkhof et al., 2017; Murphy, Jordan, Hunter, Cooney, & Casey, 2015).

CONCLUSION

Based on this process evaluation, the tablet-based FindMyApps program seems to be a useful tool for people with dementia/MCI and their caregivers. To ensure robust outcomes of a definitive trial evaluating FindMyApps, some important modifications to the intervention and the trial protocol should be made. This process analysis will aid in interpreting the outcomes of the pilot RCT (results expected 2020) and in the further development of the FindMyApps app.

Disclosure of interest

The authors report no conflict of interest.

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