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REVIEW

Are people with mild dementia able to (re)learn how to use technology? A literature review

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ABSTRACT

Objective: There is growing evidence that people with mild dementia can benefit from using tablets and apps. Due to their cognitive decline, people with dementia need support in learning how to use these devices. The objective of this review was to identify which training interventions work best to help people with mild dementia (re)learn how to use technologies, including handheld touchscreen devices. Because the uptake of these devices in people with dementia is quite new, training interventions for the use of other technologies were also included, such as technologies assisting people in Instrumental Activities of Daily Living (IADL).

Design: An electronic search was conducted in the following databases: PubMed, APA PsycInfo (EBSCO), and CINAHL (EBSCO). Themes discussed include the learning effects; training method (e.g. errorful (EF) and errorless (EL) learning); training intensity and setting; technology task type; dementia type and severity; and study design and outcome measures.

Results: In total, 16 studies were included. All studies reported positive learning effects and improved task performance in people with dementia, regardless of dementia severity, training intensity, setting, and the method used. Although the EL training method was successful more often than the EF training method, it would be inappropriate to conclude that the EL method is more effective, because the majority of studies only investigated EL training interventions with (multiple) single-case study designs.

Conclusion: Future research should consider using more robust study designs, such as RCTs, to evaluate the effectiveness of training interventions for (re)learning technology-orientated tasks, including operating handheld touchscreen devices.

Key words: dementia, technology, Instrumental Activities of Daily Living (IADL), tablet computers, training interventions, errorless learning, effectiveness

Introduction

In the early stages of the disease, people with dementia and informal carers experience insufficient support for self-management (Martin *et al.*, 2012) and a lack of meaningful activities to spend the day (Castillo *et al.*, 2010; Castillo *et al.*, 2013; Van der Roest *et al.*, 2009). Facilitating self-management and meaningful activities for people with dementia promotes autonomy and wellbeing and relieves the burden of informal carers (Graff *et al.*, 2006). Technology can potentially support people in their ability to manage life and to engage in meaningful activities despite chronic diseases (Huber *et al.*, 2011). Handheld touchscreen devices, such as tablets and their applications (apps), provide an intuitive and user-friendly interface. The use of tablets for eHealth purposes is increasing as the availability of new apps in the field of health and social care increases (Marceglia *et al.*, 2012). In recent years many Information Communication Technology (ICT) applications that support independence in daily living have been developed, such as apps for cognitive training, calendar, games, and

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art, which can also be used by people with dementia (Hitch *et al.*, 2017; Joddrell and Astell, 2016; Tyack and Camic, 2017).

There is growing evidence that people with mild dementia are able to use tablets and apps (Tyack *et al.*, 2015; Astell *et al.*, 2016; Cutler *et al.*, 2016; Groenewoud *et al.*, 2017; Kerkhof *et al.*, 2015; Lim *et al.*, 2013; Upton *et al.*, 2011) which stimulate self-management activities, e.g. apps to cope with memory loss (Kerkhof *et al.*, 2015; Øksnebjerg *et al.*, 2020), and which engage people with dementia in meaningful activities, e.g. apps for leisure activities (Smith and Mountain, 2012) such as gaming (Astell *et al.*, 2016; Groenewoud *et al.*, 2017) or art (Tyack *et al.*, 2015). However, people with dementia need support to learn how to use the tablet and its apps (Groenewoud *et al.*, 2017; Kerkhof *et al.*, 2015; Lim *et al.*, 2013; Upton *et al.*, 2011).

Introducing tablets to community-dwelling people with mild dementia is a new development. It may therefore be important to take into account specific preconditions, such as related to their cognitive disabilities and living situation (e.g. cohabiting with an informal carer or living alone). To this end, a person-centered tablet programme to assist people with mild dementia and their carers in the effective usage of tablets will be developed in co-creation with end users (Kerkhof *et al.*, 2016). This programme consists of a selection tool to help users find apps for self-management and meaningful activities and a training for informal carers to support people with dementia in using the tablet. This training will be based on available evidence on effective coaching interventions for people with dementia to (re)learn the use of technologies.

Kessels and Joosten-Weyn Banningh (2008) describe that new skills can be taught to people with dementia using their implicit memory. This part of the long-term memory is responsible for performing procedural tasks that are acquired through fixed routines, such as biking and washing hands, and are conducted automatically (Kessels and Joosten-Weyn Banningh, 2008).

The review by De Werd *et al.* (2013) found that an Errorless (EL) learning approach is more effective than an Errorful (EF) learning approach to teach people with dementia a variety of daily tasks or skills. EL approaches keep errors during the learning process to a minimum, because memory limitations prevent learning from mistakes (Clare and Jones, 2008; De Werd *et al.*, 2013). EL employs error-reduction methods, such as a stepwise approach with feedforward instruction, vanishing cues and spaced retrieval (Clare and Jones, 2008; De Werd *et al.*, 2013). Another review indicates that spaced-retrieval training is effective in enabling people with dementia to learn new information and to teach associations between a cue and a specific behavior in order to improve performance of skills (Creighton *et al.*, 2013). In EF approaches, the idea is that skills can be learned by guessing the correct response and learning from any errors made (Bourgeois *et al.*, 2016).

EL might be the best way to introduce tablets to people with dementia, but because of the broad scope of both reviews (Creighton *et al.*, 2013; De Werd *et al.*, 2013) – they included studies with a wide range of activities of daily living, such as relearning names of persons and objects – they are not conclusive about the effectiveness of EL specifically for (re)learning skills for using technologies. It is uncertain whether EL is the best approach for people with dementia to (re)learn the use of technology. For example, the stepwise approach may not be suitable when learning to use ICT applications, because the actions needed when using ICT are not as predictable as relearning names of objects or executing ADL. The (re)learning of technology is a different process. This becomes clear by acknowledging the three layers of technology significance formulated by Martins and Dal Sasso (2008): that of physical objects (such as instruments and machines); that of a form of knowledge (such as how to use it); and as it forms part of a complex set of human activities (Martins and Dal Sasso, 2008). Hence, only studies with training interventions focusing on (re)learning how to use technologies have been included in this review. Because the uptake of Information Communication Technology (ICT) applications is a recent development in people with dementia and relatively few publications were therefore expected in this area, we also included training interventions for the use of other technologies, such as technologies to assist people in Instrumental Activities of Daily Living (IADL), e.g. microwaves and coffee makers.

To the best of our knowledge, no review has been conducted that examines which training interventions are most appropriate to assist people with mild dementia in (re)learning to use technologies. The purpose of this literature review is to identify which training interventions work best in helping people with mild dementia (re)learn how to use technologies, in particular the tablet. To gain insight into the context of the included studies, the following characteristics were described: (a) dementia type and severity; (b) technology task type; (c) training intensity and setting; (d) components training; (e) study design and outcome measures; and (f) learning effects and efficiency.

The research question is:

- Which training interventions are effective for people with mild dementia in (re)learning how to use technologies, including handheld touchscreen devices?

Table 1. Search strategy in PubMed

("Dementia"[Mesh] OR dementia* [tiab] OR alzheimer* [tiab]) AND
("Learning"[Mesh] OR "Teaching"[Mesh] OR learning* [tiab] OR relearning [tiab] OR coaching* [tiab] OR training* [tiab] OR teaching* [tiab] OR errorless* [tiab] OR error free [tiab] OR errorfree [tiab] OR spaced retrieval [tiab] OR mnemonic* [tiab] OR semantic elaboration [tiab] OR subject-performed task* [tiab] OR vanishing cues [tiab] OR cueing* [tiab] OR trial and error* [tiab] OR errorful* [tiab] OR cognitive rehabilitation [tiab] OR cognitive intervention* [tiab] OR memory rehabilitation [tiab] OR "Neurological Rehabilitation"[Mesh] OR "Memory, Long-Term"[Mesh] OR implicit memory [tiab] OR procedural memory [tiab] OR long-term memor* [tiab] OR longterm memor* [tiab]) AND
("Cell Phone"[Mesh] OR "Cell Phone Use"[Mesh] OR "Mobile Applications"[Mesh] OR "Computers, Handheld"[Mesh] OR "Self-Help devices" [Mesh] OR cell phone* [tiab] OR touch screen* [tiab] OR touchscreen* [tiab] OR computer application* [tiab] OR apps [tiab] OR iPad* [tiab] OR tablet [tiab] OR smartphone* [tiab] OR smart phone* [tiab] OR mobile phone* [tiab] OR iPhone* [tiab] OR assistive technolog* [tiab] OR self-help device* [tiab] OR assistive device* [tiab] OR memory aids [tiab] OR mobile device* [tiab] OR hand-held device* [tiab] OR handheld device* [tiab] OR palmtop computer* [tiab] OR hand-held computer* [tiab] OR handheld computer* [tiab] OR palmtop device* [tiab] OR wearable* [tiab] OR cellular phone* [tiab] OR mobile app [tiab] OR mobile application* [tiab] OR mobile technolog* [tiab] OR electronic application* [tiab] OR electronic device* [tiab] OR "Activities of Daily Living"[Mesh] OR everyday activit* [tiab] OR everyday skill* [tiab] OR ADL [tiab] OR IADL[tiab] OR daily life activit* [tiab] OR everyday life functioning* [tiab] OR skill learning [tiab] OR skills learning [tiab] OR daily activit* [tiab] OR activities of daily li* [tiab] OR activity of daily li* [tiab] OR cooking activit* [tiab] OR functional life skill* [tiab] OR daily living task* [tiab] OR self-care skill* [tiab] OR route finding [tiab] OR way finding [tiab] OR orientation skill* [tiab] OR everyday functioning* [tiab])

Method

Design

A literature review (Grant and Booth, 2009) with a systematic approach was performed in order to find training interventions for (re)teaching people with mild dementia how to use technologies. Our intention was not to get a full picture of all available evidence, but rather to understand what works best for people with mild dementia to (re)learn the use of technology, so we can include these insights in our training for the person-centered tablet programme (Kerkhof *et al.*, 2016). We did not perform a complete systematic review. We used systematic review methods for transparency and reproducibility of our work, such as methods for determining the search strategy, for setting the inclusion and exclusion criteria based on PICO, and for the selection of publications and the data extraction procedure as described below (Higgins and Green, 2011).

Data sources and search strategy

A systematic search of the literature was conducted in 3 electronic databases (CP). PubMed, APA PsycInfo (EBSCO), and CINAHL (EBSCO) were searched from inception up to 19 June 2020 with comparable search strategies (see Table 1 for the search strategy used for PubMed). The complete search strategies for the other databases are available on request.

Inclusion and exclusion criteria

For the selection of the articles, we used the inclusion and exclusion criteria presented in Table 2.

Selection of publications

The search results were uploaded into EndNoteX7. Duplications were removed. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis flow diagram (Moher *et al.*, 2009) were used to summarize the study selection processes (see Figure 1). Two researchers (YK and AB) independently screened the publications, by title and abstract, and three researchers (YK, AB, and FM) independently screened the publications' full texts. In this phase further duplicates, not previously detected by EndNote, were removed. Any discrepancies between researchers regarding inclusion were resolved through discussion.

Data extraction and data synthesis

Initially, two researchers (YK and AB) independently extracted data from one included article and this was followed by a consensus meeting. Next, data were extracted from another article by the same researchers. When this resulted in similar outcomes, it was decided to divide the remaining articles and to extract the data independently. For data extraction concerning the effectiveness of training interventions and maintenance of treatment gains, additional consensus meetings took place (YK and AB). Small samples ($n < 26$) were used in 13 of the 16 studies reviewed, and the training interventions and procedures, outcomes of learning effects and research designs varied considerably among studies. We therefore performed a qualitative analysis on previously described characteristics.

Table 2. Inclusion and exclusion criteria for this literature review

INCLUSION CRITERIA	EXCLUSION CRITERIA
Population: the study population consists of people living with dementia (all types). People with mild (MMSE 21–25, GDS 4) and moderate (MMSE 11–20, GDS 5) dementia were included (Perneczky *et al.*, 2006; Reisberg *et al.*, 1982), on the assumption that training interventions effective for people with moderate dementia, i.e. people with more severe cognitive disabilities, will also be helpful for people with mild dementia.	**Population:** The study population consists of people with severe dementia, who would not be capable of using touchscreen devices. We also excluded mild cognitive impairment (MCI), memory or cognitive decline without diagnosis of dementia or without MMSE/GDS score indicating mild to moderate dementia, to ensure that results were relevant for our target group.
Intervention: the study used training interventions to (re) learn technology, more specifically: learning, training, or coaching strategies or rehabilitation techniques that focus on implicit/procedural memory and explicitly target the use of technology by individuals with dementia.	**Population:** The study included mixed populations (e.g. people with dementia in addition to people with stroke or traumatic brain injury or intellectual disabilities), unless the data of subgroups of people with mild to moderate dementia was specified in the analyses and results section of the paper.
Intervention: The task type described in the study is 'technology use' either related to (1) Instrumental Activities of Daily Living (IADL), such as voicemails, microwaves, answering machines, coffee makers and MP3 players, and/or to (2) new technologies, i.e. ICT applications, such as computers, memory aids, touchscreen devices, prompting or tracking devices, etc.	**Intervention:** The study included training interventions on which insufficient information was provided to reproduce the training.
Comparison and study design: The study utilized an experimental or quasi-experimental research design with comparison with a control group or control condition (comparing training interventions (e.g. EL with EF) or no treatment).	**Publication status:** The study was only published as an abstract, editorial comment, commentary, letter, congress paper, thesis, or study protocol.
Comparison and study design: The study utilized (multiple) controlled (control group or control condition) single-case studies or single-case studies with a measurement at baseline and after the intervention (e.g. multiple-baseline design or reversal design) or measurements of number of correct responses/correctly executed steps after each learning session.	
Outcome: The study evaluated the learning effects of training interventions including outcome measures related to optimizing the (re)learning of skills (De Werd *et al.*, 2013) e.g. number of correct responses or correctly executed steps or functional performances according to the degree of assistance.	
Timeframe for follow-up: there were no time restrictions for follow-up.	
Publication language: The study was published in English and/or Dutch and was published in a scientific journal.	

Results

The search in the PubMed, PsycINFO, and CINAHL databases resulted in a total of 3,654 references of which 3,638 were excluded either because they did not meet the inclusion criteria (see Figure 1). The study selection resulted in 16 articles describing training interventions to assist people with mild dementia in (re)learning how to use technology. Table 3 shows a detailed description of each study.

Dementia type and severity

The most common diagnosis was Alzheimer's disease (Bier *et al.*, 2008; Bourgeois *et al.*, 2016; Dechamps *et al.*, 2011; Foloppe *et al.*, 2015; Imbeault *et al.*, 2014; 2016; 2018; Kelly *et al.*, 2019; Lekeu *et al.*, 2002; Quittre *et al.*, 2005; Thivierge *et al.*, 2008; 2014; Voigt-Radloff *et al.*, 2017). One study reported mixed type (Bier *et al.*, 2008), others mentioned semantic dementia (Bier, Paquette and Macoir, 2015; Bier *et al.*, 2015), and in one study the form of dementia

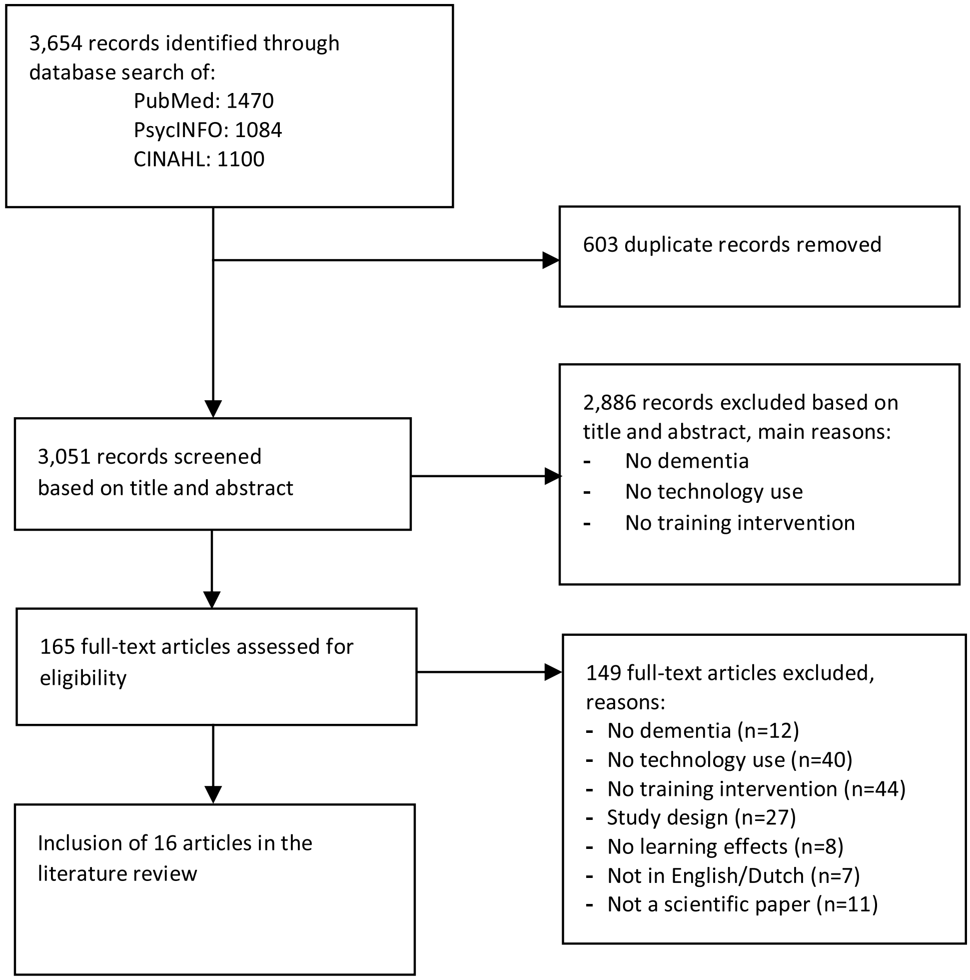

Figure 1. Flow diagram of the search and the selection process (Moher *et al.*, 2009).

was not specified (Van Tilborg *et al.*, 2011). With regard to the severity, most studies reported MMSE/MoCa scores between 11 and 25, indicating a mild to moderate dementia. Two single-case studies did not mention scores, but based on the case description we can assume it was mild dementia (Bier *et al.*, 2015; Imbeault *et al.*, 2018).

Technology task type

The technology tasks ranged from using telephones and (mobile) ICT devices, to using music and television devices, and conducting household activities and operating household devices (IADL). Examples of telephone and (mobile) ICT devices were learning to operate a:

- voicemail and answering machine (Thivierge *et al.*, 2008);
- (mobile) phone (Kelly *et al.*, 2019; Lekeu *et al.*, 2002; Voigt-Radloff *et al.*, 2017);
- smartphone/tablet and its apps (Bier *et al.*, 2015; Bier *et al.*, 2015; Imbeault *et al.*, 2018);
- computer, to use e-mail, Internet search and computer games (Dechamps *et al.*, 2011; Thivierge *et al.*, 2014).

Two studies described people with dementia learning to use the AP@LZ application (Imbeault *et al.*, 2014; 2016). AP@LZ is an electronic personal organizer application, developed for people with dementia and installed on a smartphone. The application consists of five functions: (1) Appointments; (2) Personal; (3) Medical; (4) Contacts; and (5) Notepad (Imbeault *et al.*, 2014; 2016).

The use of music and television devices consisted, for example, of learning to operate a:

- radio and video cassette (Bier *et al.*, 2008; Thivierge *et al.*, 2014);
- remote control (Dechamps *et al.*, 2011; Voigt-Radloff *et al.*, 2017);
- CD player and DVD player with leisure activities, such as Wii game and origami (Dechamps *et al.*, 2011; Thivierge *et al.*, 2014).

Table 3. Detailed description of reviewed studies

Study	*N*	MMSE/ MoCA score	Dementia type/ severity	Technology task type	Training intensity	Training setting	Components of coaching intervention	Study design	Outcome measures learning effects	Effectiveness (+/−)[a] (performance pre- and post-intervention on scale of 0–100)	Maintenance of treatment gains (+/−) (performance on scale of 0–100)[b]
3a Group studies (RCTs and quasi-experimental designs) using EL and/ or EF approaches to (re)learning mostly IADLs											
(Bourgeois *et al.*, 2016)	52	MMSE (mean) 17	Mild to moderate Alzheimer's dementia	3 mostly IADL tasks per person, such as using the stove, an alarm clock or preparing tea	12 sessions of two hours over 6 weeks (two sessions per week)	?	EL elements in two methods; 1. Stepwise approach 2. Modeling with SR 3. EF approach	Randomized prospective clinical trial (group study)	Number of correct responses or correctly executed steps: - after each learning session - at baseline and post-intervention	**EL: + (21–62)** **Modeling & SR: + (20–56)** **EF: + (23–64)**	*After 4 weeks*[c] EL: + (47) Modeling & SR: + (55) EF: + (57)
(Dechamps *et al.*, 2011)	14	MMSE (mean) 15	Mild to moderately severe Alzheimer's	3 mostly IADL tasks per person, such as using an electric kettle, coffee machine, and remote control	6 sessions of 30 minutes within one week (per task)	Nursing home	EL elements in two methods; 1. Stepwise approach 2. Modeling with SR 3. EF approach	Within-subject design (group study)	Number of correct responses or correctly executed steps: - after each learning session - at baseline and post-intervention	**EL stepwise: + (49–63) Modeling (44–74)** **EF: + (45–59)**	*After 3 weeks* EL stepwise: + (73) Modeling + (75) EF: + (52)
(Thivierge *et al.*, 2014)	17	MMSE (mean) 21	Mild to moderate Alzheimer's dementia	1 task per person, such as using television or music devices and computer apps (Wii game and origami)	2 sessions of 45–60 minutes a week, over 4 weeks	At home	EL elements with SR	A block-randomized cross-over controlled study (group study)	Functional performances according to the degree of assistance: - at baseline and post-intervention	**EL & SR Group 1: + (75–90)** **EL & SR Group 2: + (77–88)**	*After 8 weeks* Group 1: + (87) Group 2: + (88)
(van Tilborg *et al.*, 2011)	26	MMSE (mean) 20	Mild to moderate dementia	Coffee machine and microwave oven	5 sessions of 15 minutes, over 2–3 days	?	EL elements in two methods: 1. Explicit method (verbal instructions & cues) 2. Implicit method (modeling & preventing errors)	Counterbalanced self-controlled cases series (group study)	Number of correct responses or correctly executed steps: - after each learning session - at baseline and post-intervention	**Explicit method: + (43–80)** **Implicit method: + (36–80)**	*After 7–10 days* Explicit method: + (80) Implicit method: + (71)
(Voigt-Radloff *et al.*, 2017)	161	MMSE (mean) 20	Mild to moderate Alzheimer's dementia or mixed dementia	2 tasks per person, such as performing light exercises, making a telephone call, choosing television broadcast and writing shopping list	8 sessions of 60 minutes over 8 weeks. A refresher training session in week 19 or 20	At home	1. EL elements 2. EF approach	Single-blind, active-controlled design (group study)	Number of correct responses or correctly executed steps: - at baseline and post-intervention	**EL: + (44–64)**[d] **EF: + (53–61)**	*After 15 weeks* EL: + (56) EF: + (56)

Table 3. Continued

Study	N	MMSE/ MoCa score	Dementia type/ severity	Technology task type	Training intensity	Training setting	Components of coaching intervention	Study design	Outcome measures learning effects	Effectiveness (+/−)[a] (performance pre- and post-intervention on scale of 0–100)	Maintenance of treatment gains (+/−) (performance on scale of 0–100)[b]
3b Experimental (multiple) single case studies using EL approach to (re)learning handheld touchscreen devices											
(Bier, Paquette and Macoir, 2015)	1	?	Semantic dementia (probable, mild)	Smartphone functions and apps	7 sessions of 1.5 hours over 7 weeks (one session per week)	?	EL elements	ABA single-case study	Number of correct responses or correctly executed steps: - after each learning session - at baseline and post-intervention	+ **(19–100)**	*After six months* + (80)
(Bier *et al.*, 2015)	1	MoCa = 23	Mild semantic dementia	Smartphone functions and apps	5 training sessions	?	EL elements	ABA single-case study	Number of correct responses or correctly executed steps: - after each learning session - at baseline and post-intervention	+ **(30–73)**	*After six months* + (78)
(Imbeault *et al.*, 2014)	2	MMSE 22, 29	Mild Alzheimer's dementia	Smartphone app AP@LZ, as electronic agenda	2 sessions of 30–40 minutes a week in first two phases (with a total of 19–38 sessions, including follow-up). In total AP@LZ use 11 – 14 months.	?	EL elements	ABA multiple single-case studies	Functional performances according to the degree of assistance: - after each learning session	Case 1: + (32–90)e Case 2: + (36–90)e	*After four weeks* Case 1: + (100). Still uses AP@LZ after 14 months (end of study) Case 2: + (50–75)f. Still uses AP@LZ after 11 months (end of study)
(Imbeault *et al.*, 2016)	2	MMSE 27,28	Mild Alzheimer's dementia	Smartphone app AP@LZ, as electronic agenda	2 sessions of 30–40 minutes/week in first two phases (total 19–25 sessions, incl. follow-up). In total AP@LZ use 2 – 10 months	?	EL elements	ABA multiple single-case studies	Functional performances according to degree of assistance: - after each learning session	Case 1: + (50–90)e Case 2: + (55–88)e	*After 10 months:* Case 1: + (100). Still uses AP@LZ after 12 months (end of the study) Case 2 not completed

Table 3. Continued

Study	N	MMSE/ MoCa score	Dementia type/ severity	Technology task type	Training intensity	Training setting	Components of coaching intervention	Study design	Outcome measures learning effects	Effectiveness (+/−)[a] (performance pre- and post-intervention on scale of 0–100)	Maintenance of treatment gains (+/−) (performance on scale of 0–100)[b]
(Imbeault et al., 2018)	1	?	Probable mild Alzheimer's dementia according to DSM- 5 criteria	General functions of the tablet and functionalities of a calendar application	2 sessions a week, for 8 weeks in first two phases (17 sessions). Follow-up 23 sessions over 12 months. 75–120 minutes during the first three sessions, later 30–45 minutes per session	?	EL elements	Exploratory single-case study	Functional performances according to the degree of assistance: - after each learning session	+ **(64-98)**[e]	*After 12 months* + (100). Still uses the tablet after 12 months (end of the study)
3c Experimental (multiple) single case studies using EL approach to (re)learning a variety of technology tasks											
(Bier et al., 2008)	1	MMSE 24	Mild Alzheimer's dementia with vascular aspects	Cassette radio and video cassette recorder	8 sessions of 1.5 hours for the cassette radio and 10 sessions for the video cassette recorder (VCR). Two sessions per week	At home	EL elements with VC and SR	ABA single-case study	Number of correct responses or correctly executed steps: - after each learning session - at baseline and post-intervention	+ **(60–87 for cassette radio & 33–100 for VCR)**	*After 9 weeks* + (70 for cassette radio & 90 for VCR). - Transfer in daily life for cassette radio and VCR).
(Foloppe et al., 2015)	1	MMSE 16	Moderate Alzheimer's dementia	Cooking tasks such as using the stove and microwave in a virtual situation. Using a coffee machine and toaster in a real situation	16 learning sessions in 4 weeks (four sessions in 4 days)	At home	EL elements with VC	Within single-case study	Functional performances according to the degree of assistance: - after each learning session - at baseline and post-intervention	**Real situation:** + **(83–94)** **Virtual situation:** + **(75–91)**	After 6 months Real situation: + (94) Virtual situation: + (95)
(Kelly et al., 2019)	2	MMSE 18, 20	Moderate Alzheimer's dementia	Case 1 Phone Case 2 Mobile phone	1 session of 60–90 minutes a week, over 8 weeks	At home	EL elements with (in case 1) VC	Multiple single-case studies	Number of correct responses or correctly executed steps[g]: - after each learning session - at baseline and post-intervention	Case 1: + (8-100) Case 2: + (50-100)	After 6 weeks Case 1: + (90) Case 2: + (80)

Table 3. Continued

Study	N	MMSE/ MoCA score	Dementia type/ severity	Technology task type	Training intensity	Training setting	Components of coaching intervention	Study design	Outcome measures learning effects	Effectiveness (+/−)[a] (performance pre- and post-intervention on scale of 0–100)	Maintenance of treatment gains (+/−) (performance on scale of 0–100)[b]
(Lekeu *et al.*, 2002)	2	MMSE 21, 22	Mild probably Alzheimer's dementia	Calling somebody on a mobile telephone	1–2 sessions of 45 minutes a week, over 3 months (13–14 sessions in total)	Ambulatory cognitive rehabilitation center	EL elements with SR	Multiple single-case studies	Number of correct responses or correctly executed steps: - after each learning session - at baseline and post-intervention	Case 1: + (33–91) Case 2: + (22–77)	*Afte 3 months* Case 1: + (100) Case 2: + (100)
(Quittre *et al.*, 2005)	1	MMSE 21	Mild probable Alzheimer's dementia	Digital clock	Two sessions a week over 3 months (21 sessions in total)	Memory center	EL elements with SR	Exploratory single-case study	Number of correct responses or correctly executed steps: - after each learning session	+ (43–100)	*After 3 months* + spontaneous use *After 6 months* + still uses the clock
(Thivierge *et al.*, 2008)	2	MMSE 19, 25	Mild to moderate Alzheimer's dementia	Case 1 voicemail and Case 2 answering machine	Two sessions of 45–60 minutes a week, over 4 weeks	?	EL elements with SR	Multiple single-case studies	Functional performances according to degree of assistance: - after each learning session - at baseline and post-intervention	Case 1: + (57–94) Case 2: + (47–75)	*After 5 weeks* Case 1: + (89) Case 2: + (83)

[a] + improvement in performance of target functions between baseline and post-intervention; – is no learning effect. The entries in bold indicate a significant effect. Performance of the task refers to performance without help, cues, or written instructions.
[b] + improvement in performance of target functions between baseline and follow-up; – means the learning effect has disappeared at follow-up. The entries in bold indicate a significant effect.
[c] After the end of the training.
[d] Average of two different tasks recalculated to scale of 0–100.
[e] At the end of acquisition and application phase.
[f] The application phase was with help from trainers.
[g] Only included objective measure of percentage of correct responses, not self-rated goal performance and satisfaction.

In other studies participants with dementia focused on (re)learning household activities such as:

- making tea (Bourgeois *et al.*, 2016; Dechamps *et al.*, 2011):
- making coffee with a coffee machine (Dechamps *et al.*, 2011; Foloppe *et al.*, 2015; Van Tilborg *et al.*, 2011);
- using the oven (Bourgeois *et al.*, 2016; Foloppe *et al.*, 2015);
- using the microwave (Foloppe *et al.*, 2015; Van Tilborg *et al.*, 2011):
- setting the alarm clock or using a digital clock (Bourgeois *et al.*, 2016; Quittre *et al.*, 2005).

Training intensity and setting

The number and duration of training sessions varied considerably between the reviewed studies. In nine studies the number of training sessions was fewer than ten, ranging from 5 to 9 sessions (Bier *et al.*, 2008; Bier, Paquette and Macoir, 2015; Bier *et al.*, 2015; Dechamps *et al.*, 2011; Kelly *et al.*, 2019; Thivierge *et al.*, 2008; 2014; Van Tilborg *et al.*, 2011; Voigt-Radloff *et al.*, 2017).

In seven studies the number of training sessions was more than ten, ranging from 12 to 39 sessions (Bourgeois *et al.*, 2016; Foloppe *et al.*, 2015; Imbeault *et al.*, 2014; 2016; 2018; Lekeu *et al.*, 2002; Quittre *et al.*, 2005; Voigt-Radloff *et al.*, 2017).

The duration of each session ranged from 15 to 120 minutes and the total training programmes were given during a period ranging from 2 days to 14 months. In three studies no duration of each session was mentioned (Bier *et al.*, 2015; Foloppe *et al.*, 2015; Quittre *et al.*, 2005), and in one study the length of the total training programme was unclear (Bier *et al.*, 2015).

With task types relating to mobile devices, such as operating a mobile phone, smartphone, or tablet and its apps, the intensity of training sessions varied among the studies. In two studies (Bier *et al.*, 2015; Bier, Paquette and Macoir, 2015) participants attended 5 to 7 sessions to learn new (smart)phone functions and apps, whereas in other studies (Imbeault *et al.*, 2014; 2016; 2018; Kelly *et al.*, 2019; Lekeu *et al.*, 2002) 8 to 14 sessions were needed.

In studies by Imbeault *et al.* (2014; 2016; 2018) a training programme developed by Sohlberg and Mateer (1989) was conducted in which participants learned to operate a smartphone or tablet and a calendar app (e.g. AP@LZ). This training programme consisted of three stages: the acquisition phase (i), where participants learned to operate the smartphone or tablet and calendar app; the application phase (ii), where participants learned "how" and "when" to use the app; and the adaption phase (iii), where participants were required to demonstrate their ability to use the app in a real-world setting (Imbeault *et al.*, 2014; 2016; 2018). An average of 10, 9, and 13 training sessions of merely 30–40 minutes were needed to complete the acquisition, application, and adaption phases respectively (Imbeault *et al.*, 2014; 2016; 2018) with one missing value because the adaption phase, in one case, was not completed (Imbeault *et al.*, 2016).

The training setting was at home (Bier *et al.*, 2008; Foloppe *et al.*, 2015; Kelly *et al.*, 2019; Thivierge *et al.*, 2014; Voigt-Radloff *et al.*, 2017), an ambulatory rehabilitation center (Lekeu *et al.*, 2002), a memory center (Quittre *et al.*, 2005), a nursing home (Dechamps *et al.*, 2011) or not specified.

Components training intervention (training method)

All reviewed studies used EL approaches and included a variety of error-reduction components for (re)teaching people with mild dementia how to use technology. Although studies varied in the level of detail of description of the training components, the following error-reduction methods, as described in the review by De Werd *et al.* (2013) were identified: no guessing; a stepwise approach; modeling; verbal instructions or visual instructions; vanishing cues and spaced retrieval.

First, in some studies participants were encouraged to avoid guessing to prevent errors (Imbeault *et al.*, 2014; Kelly *et al.*, 2019; Lekeu *et al.*, 2002; Voigt-Radloff *et al.*, 2017). When errors occurred, the therapist/researcher intervened offering the correct response and/or steps were repeated to prevent errors (Bier, Paquette and Macoir, 2015; Bier *et al.*, 2015; Bourgeois *et al.*, 2016; Foloppe *et al.*, 2015; Imbeault *et al.*, 2014; 2016; 2018; Lekeu *et al.*, 2002; Van Tilborg *et al.*, 2011; Voigt-Radloff *et al.*, 2017).

Second, a stepwise approach was applied in all the studies except one (Quittre *et al.*, 2005) and this was done by dividing tasks into small steps.

Third, participants received a demonstration of how each step had to be performed (modeling), supported by verbal or visual instructions (Bier, Paquette and Macoir, 2015; Bier *et al.*, 2015; Bourgeois *et al.*, 2016; Dechamps *et al.*, 2011; Foloppe *et al.*, 2015; Imbeault *et al.*, 2016; 2018; Thivierge *et al.*, 2008; 2014; Van Tilborg *et al.*, 2011; Voigt-Radloff *et al.*, 2017). In other studies, participants received verbal and/or visual instructions without physical demonstration (Bier *et al.*, 2008; Kelly *et al.*, 2019; Lekeu *et al.*, 2002; Quittre *et al.*, 2005; Van Tilborg *et al.*, 2011).

Fourth, the method of vanishing cues (VC), which refers to gradually withholding cues after successful response performance (De Werd *et al.*, 2013) was applied in three studies (Bier *et al.*, 2008; Foloppe *et al.*, 2015; Kelly *et al.*, 2019). Last, the spaced retrieval (SR) method, referring to increasing recall intervals after reproducing the desired response (De Werd *et al.*, 2013), was applied in six studies (Bourgeois *et al.*, 2016; Dechamps *et al.*, 2011; Lekeu *et al.*, 2002; Quittre *et al.*, 2005; Thivierge *et al.*, 2008; 2014).

Three studies used not only EL but also EF approaches (Bourgeois *et al.*, 2016; Dechamps *et al.*, 2011; Voigt-Radloff *et al.*, 2017). One study examined the effectiveness of EF in addition to EL approaches (Bourgeois *et al.*, 2016) and in two of the studies EF was applied as a control condition for EL method(s) (Dechamps *et al.*, 2011; Voigt-Radloff *et al.*, 2017).

Study design and outcome measures

Five studies used a group experimental design, three were randomized controlled trials (RCTs) and two had quasi-experimental designs. Two RCTs compared different training interventions (Bourgeois *et al.*, 2016; Voigt-Radloff *et al.*, 2017) and in one RCT the training intervention was compared with controls on the waiting list (Thivierge *et al.*, 2014). As to the quasi-experimental designs, one study used a within-subject design in which participants received three different training interventions (Dechamps *et al.*, 2011), the other study used a counterbalanced self-controlled cases series in which both healthy controls and participants with dementia were trained individually (Van Tilborg *et al.*, 2011). Eleven articles reported experimental case studies, of which six were single-case studies (Bier *et al.*, 2008; 2015; Bier, Paquette and Macoir, 2015; Foloppe *et al.*, 2015; Imbeault *et al.*, 2018; Quittre *et al.*, 2005) and five multiple single-case studies (Imbeault *et al.*, 2014; 2016; Kelly *et al.*, 2019; Lekeu *et al.*, 2002; Thivierge *et al.*, 2008). Three single-case studies and three multiple single-case studies applied an ABA design, where A represents the measurements and B the intervention (Bier *et al.*, 2008; Bier, Paquette and Macoir, 2015; Bier *et al.*, 2015; Imbeault *et al.*, 2014; 2016; Lekeu *et al.*, 2002). One single-case study (Bier, Paquette and Macoir, 2015) and three multiple single-case studies had a multiple baseline design (Imbeault *et al.*, 2014; 2016; Kelly *et al.*, 2019), one study a multiple baseline design by activity (Bier *et al.*, 2008) and one study a multiple-baseline across-subjects design (Thivierge *et al.*, 2008).

In all studies, the number (percentages) of correct responses or correctly executed steps done without help was an important outcome measure and of these studies the number of correct responses or correct steps was assessed during the intervention with the exception of two studies (Thivierge *et al.*, 2014; Voigt-Radloff *et al.*, 2017). In twelve studies the number of correct responses or correct steps was measured at baseline and at post-intervention assessments (Bier *et al.*, 2008; Bier, Paquette and Macoir, 2015; Bier *et al.*, 2015; Bourgeois *et al.*, 2016; Dechamps *et al.*, 2011; Foloppe *et al.*, 2015; Kelly *et al.*, 2019; Lekeu *et al.*, 2002; Thivierge *et al.*, 2008; 2014; Van Tilborg *et al.*, 2011; Voigt-Radloff *et al.*, 2017). In some studies, the response was scored according to the degree of assistance needed to perform the task (Foloppe *et al.*, 2015; Imbeault *et al.*, 2014; Imbeault *et al.*, 2016; 2018; Thivierge *et al.*, 2008; 2014) and in two studies performance of tasks was divided into implicit performance (or knowledge) and explicit performance (or knowledge) (Bourgeois *et al.*, 2016; Dechamps *et al.*, 2011). All studies reported the maintenance of treatment gains. In twelve studies follow-up assessments were performed and in the remaining four studies it was reported how participants used the learned technology in a real-life context (Imbeault *et al.*, 2014; 2016; 2018; Quittre *et al.*, 2005).

Learning effects and efficiency

Group studies (RCTs and quasi-experimental designs) using EL and/or EF approaches to (re)learning mostly IADLs (Table 3a)

In five experimental group studies, three RCTs and two quasi-experimental designs, the training interventions contributed to significant improvements in task performance at post measures including follow-up (Bourgeois *et al.*, 2016; Dechamps *et al.*, 2011; Thivierge *et al.*, 2014; Van Tilborg *et al.*, 2011; Voigt-Radloff *et al.*, 2017). An average of 46% in performance across studies at baseline improved to 60% at post measures, which was maintained at follow-up assessments with an average of 60% after 6 weeks (range from 1.5 to 15 weeks). The studies, one with a sample size of $n = 161$ (Voigt-Radloff *et al.*, 2017), showed that participants with dementia were able to relearn, mostly IADL-orientated tasks, regardless of the type of training intervention, i.e. EL approaches versus EF approach (Bourgeois *et al.*, 2016; Voigt-Radloff *et al.*, 2017) or explicit (verbal instructions, with errors) versus implicit (modeling, preventing errors) training intervention methods (Van Tilborg *et al.*, 2011). In one study performances of the implicit training method in both the control and the experimental group decreased significantly at follow-up compared to post-intervention (Van Tilborg *et al.*, 2011) and in another study performance in the EL group decreased the most at follow-up (Bourgeois *et al.*,

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2016). However, in one study with a small sample size ($n = 14$) the EL approach, consisting of modeling with SR and a stepwise approach with feed-forward instruction, resulted in a significantly better learning effect compared to the EF approach (Dechamps *et al.*, 2011). There was even a slight improvement after EF at post measures, which was not, however, maintained at a 3-week follow-up (Dechamps *et al.*, 2011). In another study, EL elements, such as a stepwise approach, modeling and SR versus no training intervention, resulted in significantly better performance of the experimental group (Thivierge *et al.*, 2014). In the experimental group studies, participants needed an average of 8 sessions of 56 min during 4 weeks to learn and improve task performance (average intervention time across the studies).

Experimental (multiple) single-case studies using EL approach to (re)learning handheld touchscreen devices (Table 3b)

The EL approach, consisting of a stepwise approach, modeling and verbal instructions, was used in three experimental single-case (Bier, Paquette and Macoir, 2015; Bier *et al.*, 2015; Imbeault *et al.*, 2018) and two multiple single-case studies (Imbeault *et al.*, 2014; 2016). Participants were taught to use a smartphone or a tablet. Studies found an improved task performance after learning sessions and/or at post measures. An average of 40% in performance across studies at baseline improved to 90% at post measures and was maintained at follow-up with an average of 78% after 33 weeks (ranged from 4 to 52 weeks). Transfer in everyday life was difficult in the two multiple single-case studies. In one case this was because the participant lived alone (Imbeault *et al.*, 2016) and in the other case the severity of the participant's cognitive problems became an obstacle (Imbeault *et al.*, 2014). In these (multiple) single-case studies participants needed an average of 9 sessions of 47 min during 5 weeks to learn and improve task performance (intervention time across the studies).

Experimental (multiple) single-case studies using EL approach to (re)learning a variety of technology tasks (Table 3c)

In one experimental single-case (Quittre *et al.*, 2005) and two multiple single-case studies (Lekeu *et al.*, 2002; Thivierge *et al.*, 2008) EL elements such as a stepwise approach were used in combination with the SR method, and in two (multiple) single-case studies (Foloppe *et al.*, 2015; Kelly *et al.*, 2019) in combination with the VC method. Participants learned to successfully operate (mobile) telephone devices and IADL (Foloppe *et al.*, 2015; Kelly *et al.*, 2019; Lekeu *et al.*, 2002; Quittre *et al.*, 2005; Thivierge *et al.*, 2008) and succeeded in maintaining autonomy in these tasks (Foloppe *et al.*, 2015; Quittre *et al.*, 2005; Thivierge *et al.*, 2008). One single-case study used three combinations of error-reduction methods to teach the participant how to use a cassette radio and video cassette recorder (Bier *et al.*, 2008). The stepwise approach with VC method was successful for learning the target functions, but maintenance, transfer, and spontaneous use of target functions, learned with the SR method, remained difficult (Bier *et al.*, 2008). In these (multiple) single-case studies, an average of 46% in performance across studies at baseline improved to 92% at post measures and it was maintained at follow-up with an average of 89% after 12 weeks (range from 5 to 26 weeks), with one missing value of performance at follow-up (Quittre *et al.*, 2005). In addition, participants needed an average of 13 sessions of 66 min during 8 weeks to learn and improve task performance (average intervention time across the studies) with two missing values of duration of sessions in minutes (Foloppe *et al.*, 2015; Quittre *et al.*, 2005).

Discussion

All studies (Bier *et al.*, 2008; Bier, Paquette and Macoir, 2015; Bier *et al.*, 2015; Bourgeois *et al.*, 2016; Dechamps *et al.*, 2011; Foloppe *et al.*, 2015; Imbeault *et al.*, 2014; 2016; 2018; Kelly *et al.*, 2019; Lekeu *et al.*, 2002; Quittre *et al.*, 2005; Thivierge *et al.*, 2008; 2014; Van Tilborg *et al.*, 2011; Voigt-Radloff *et al.*, 2017) that were included in this review reported improvements in task performance in people with dementia (re)learning how to use technology, regardless of training intensity, setting, and method they used and whether they had mild or moderate dementia. The successes were not limited to the studies that used EL and were not limited to simpler tasks, such as making tea with an electric kettle.

In the experimental group studies, we did not find evidence that EL, compared to EF, resulted in e.g. improved task performance, except in one study (Dechamps *et al.*, 2011) with a smaller sample size. This is in contrast with the findings of De Werd *et al.* (2013), who concluded that EL is more effective than EF for people with dementia when learning everyday tasks. However, they also included studies that focus on (re)learning names of objects or other daily tasks instead of solely focusing on the use of technologies. In most of the studies in the review by De Werd *et al.* (2013), only error-reduction training interventions were used, which resulted in improved task performance. Also, in most of the studies included in our review, i.e. in two experimental group studies (Thivierge *et al.*, 2014; Van Tilborg *et al.*, 2011) and eleven experimental (multiple) case studies (Bier *et al.*, 2008; Bier, Paquette and Macoir, 2015; Bier *et al.*, 2015; Foloppe *et al.*, 2015; Imbeault *et al.*, 2014; 2016; 2018; Kelly *et al.*, 2019; Lekeu *et al.*, 2002; Quittre *et al.*, 2005; Thivierge *et al.*, 2008), only error-reduction (EL) training interventions were used. Although the EL training generally resulted in improved outcomes, the task performances in three studies using EF training interventions also improved. Hence, based on this review we cannot conclude that EL training interventions are more effective than EF training interventions. Nevertheless, our review contributes to additional evidence for the potential impact of EL training interventions when people with mild to moderate dementia (re)learn how to use technology.

Most of the studies included in this review used a combination of error-reduction training interventions, i.e. a stepwise approach with a demonstration of steps (modeling) supported by verbal or visual instructions. Unfortunately, the content of training components between the different studies is inconsistent and studies also vary regarding the details described in the training components. This makes it difficult to determine which components contribute most to learning. Also, combinations of EL elements with SR and VC were tested, which generally resulted in positive outcomes (Bier *et al.*, 2008; Foloppe *et al.*, 2015; Kelly *et al.*, 2019; Lekeu *et al.*, 2002; Quittre *et al.*, 2005; Thivierge *et al.*, 2008), which is in line with findings of previous reviews (Creighton *et al.*, 2013; De Werd *et al.*, 2013; Hopper *et al.*, 2013) and with studies on supporting people with mild to moderate dementia in IADL that did not meet the inclusion criteria of our search (Germain *et al.*, 2019; Kurth *et al.*, 2020).

When we focus on training interventions for people with mild dementia to (re)learn how to use the smartphone or tablet, which was the specific purpose of this review, studies of Bier *et al.* (2015) showed that fewer EL sessions (5–7) were needed for learning new smartphone functions than the 8–12 sessions needed in the studies by Imbeault *et al.* (2014; 2016; 2018). Moreover, in studies by Bier *et al.* (2015) these sessions proved to be sufficient for continued regular use of half of the learned app functions at a six-month follow-up. In the studies by Imbeault *et al.* (2014; 2016; 2018), on the other hand, from 5 to 16 sessions were needed to learn "how" and "when" to use the app, and from 5 to 23 extra sessions were needed for transfer to/spontaneous use in daily life, and this remained difficult in two cases (Imbeault *et al.*, 2014; 2016). Possible explanations for these variations in training sessions may be that participants in the studies conducted by Imbeault *et al.* (2014; 2016) were older, had Alzheimer's dementia, one participant lived alone and none of the participants had touchscreen experience. In studies of Bier *et al.* (2015), participants were relatively young, had Semantic Dementia, all lived with their partner and they already had touchscreen experience. Other studies acknowledge that people are more likely to be able to engage with technology if they have learned how to use it before the onset of dementia (Naumann *et al.*, 2011; Tyack and Camic, 2017) and that support of informal carers in the home environment must be sufficiently frequent and ongoing (Hitch *et al.*, 2017).

Nowadays the use of ICT applications is becoming an integral part of everyday life, even among the older generation and people with dementia. Recent reviews show that touchscreen technology is feasible and can improve the well-being of people with dementia (Hitch *et al.*, 2017; Joddrell and Astell, 2016; Tyack and Camic, 2017). This increases the need to design digital systems and applications that can be used by all, regardless of physical or cognitive impairments (Gibson *et al.* 2016), along with appropriate support for learning to use them (Hitch *et al.*, 2017).

Strengths and limitations

This is the first review that examines which training interventions are most appropriate for people with mild dementia to (re)learn how to perform technology-orientated tasks. This review contributes to the body of knowledge concerning effective training interventions to help people with dementia (re)learn how to use technology, including the use of touchscreen technology. This is important, because so far it is unclear whether proven best learning methods for people with mild to moderate dementia are also applicable to the teaching of how to use technologies that are complex and at times may be difficult to learn.

The scarcity of available studies forced us to include different study designs with different levels of evidence. We included quasi-experimental and (multiple) single-case studies with small sample sizes in this review, because RCTs were limited for technology training interventions studies in people with dementia, which is also acknowledged in De Werd *et al.* (2013).

Another potential limitation is that this review may not have included all studies that involved training interventions to assist people with mild to moderate dementia in learning to use technology, as we only searched databases related to health and social sciences, not databases specifically related to technology only. However, relevant journals focusing on a combination of healthcare and technology were also indexed in these databases. We may have missed studies due to the selected keywords we used when searching, but we made a concerted effort to be as comprehensive as possible. Although our search strategy had a broad set-up and covered a wide range of training interventions and we used a transparent selection process, all studies included in this literature review used the EL approach as a training intervention. Moreover, only studies in English and Dutch were included. This may have caused publication bias within and across studies.

Implications for research and practice

Regarding the uptake of touchscreen technology by people with mild dementia, there is a growing need to build on evidence that supports best practice and to recommend and implement meaningful activities via handheld touchscreen devices (Hitch *et al.*, 2017). Therefore, more evidence is necessary to find the most appropriate and effective training interventions to help people with mild dementia learn these skills and informal carers how they can support this. To date high quality training intervention studies are lacking, the included studies had small sample sizes and many of them were (multiple) single-case studies. Moreover, the content of the training interventions was not consistently described and used across studies. This makes it difficult to draw conclusions on which training interventions are most successful. In addition, there was little variation in training interventions, the EL approach was included in all studies. In future studies, in addition to EL, investigation of other training interventions for (re)learning the use of technology, such as associative learning (Caffò *et al.*, 2014), is recommended. Furthermore, there is a lack of reliable information about how informal carers can successfully support their relatives with dementia during training intervention. In the studies described in this review, the researchers or therapists provided the training, but successful implementation in the home environment requires ongoing support of informal carers (Hitch *et al.*, 2017). Although training interventions to assist those with mild to moderate dementia to (re)learn technology-driven tasks proved to be feasible, the findings were not comparable due to the variations in study design, content of training interventions and technology tasks. Future studies should consider using more consistent training methodologies and more robust study designs, such as RCTs, to evaluate the effectiveness of training interventions for (re)learning technology-orientated tasks, including tasks to operate mobile ICT devices.

Conclusion

It is promising that people with mild dementia can (re)learn technology-driven tasks such as using handheld touchscreen devices. An increasing number of ICT applications for self-management and meaningful activities, which can also potentially support people with mild dementia, are becoming available. This may help increase their autonomy and reduce social exclusion, and thereby improve their quality of life.

Conflict of interest

None.

Description of authors' roles

Y. Kerkhof designed and conducted the literature review and wrote the draft of the manuscript. Y. Kerkhof and C. Planting developed the search strategies and C. Planting conducted the search in the databases. Y. Kerkhof, A. Bergsma, and F. Mangiaracina contributed to the article selection and Y. Kerkhof and A. Bergsma contributed to the data extraction. A. Bergsma, M. Graff, and R. M. Dröes supervised the study. All authors contributed to the design of the study, provided comments on, and edited drafts of the manuscript. All authors agreed on the submission of the manuscript.

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