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A virtual reality intervention to improve the understanding and empathy for people with dementia in informal caregivers: results of a pilot study

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ABSTRACT

Objective: Informal caregivers often experience psychological distress due to the changing functioning of the person with dementia they care for. Improved understanding of the person with dementia reduces psychological distress. To enhance understanding and empathy in caregivers, an innovative technology virtual reality intervention Through the Dementia Lens (TDL) was developed to experience dementia, consisting of a virtual reality simulation movie and e-course. A pilot study of TDL was conducted.

Methods: A pre-test–post-test design was used. Informal caregivers filled out questionnaires assessing person-centeredness, empathy, perceived pressure from informal care, perceived competence and quality of the relationship. At post-test, additional questions about TDL’s feasibility were asked.

Results: Thirty-five caregivers completed the pre-test and post-test. Most participants were satisfied with TDL and stated that TDL gave more insight in the perception of the person with dementia. The simulation movie was graded 8.03 out of 10 and the e-course 7.66. Participants significantly improved in empathy, confidence in caring for the person with dementia, and positive interactions with the person with dementia.

Conclusion: TDL is feasible for informal caregivers and seems to lead to understanding of and insight in the experience of people with dementia. Therefore, TDL could support informal caregivers in their caregiving role.

Introduction

The total number of people with dementia worldwide is currently estimated at 47.5 million and this number is expected to increase to 135.5 million by 2050 (World Health Organization, 2016). As in other countries, in the Netherlands the majority of the people with dementia live at home (Alzheimer’s Association, 2015; Dutch Alzheimer’s Society, 2016; Johns Hopkins Medicine, 2013; Prince et al., 2015). This percentage is also expected to increase since current policy is to increase to 135.5 million by 2050 (World Health Organization, 2016). Alzheimer’s Australia Vic developed a VR tool that simulates thoughts, fears, and challenges of a person living with dementia on a large screen (Alzheimer’s Australia Vic, 2016). However, these caregivers often experience psychological distress due to the changing functioning of the person with dementia they care for. Improved understanding of the person with dementia reduces psychological distress. To enhance understanding and empathy in caregivers, an innovative technology virtual reality intervention Through the Dementia Lens (TDL) was developed to experience dementia, consisting of a virtual reality simulation movie and e-course. A pilot study of TDL was conducted.

Methods: A pre-test–post-test design was used. Informal caregivers filled out questionnaires assessing person-centeredness, empathy, perceived pressure from informal care, perceived competence and quality of the relationship. At post-test, additional questions about TDL’s feasibility were asked.

Results: Thirty-five caregivers completed the pre-test and post-test. Most participants were satisfied with TDL and stated that TDL gave more insight in the perception of the person with dementia. The simulation movie was graded 8.03 out of 10 and the e-course 7.66. Participants significantly improved in empathy, confidence in caring for the person with dementia, and positive interactions with the person with dementia.

Conclusion: TDL is feasible for informal caregivers and seems to lead to understanding of and insight in the experience of people with dementia. Therefore, TDL could support informal caregivers in their caregiving role.

One way to improve the understanding of people with dementia is to take their perspective and thereby experience what it is like to have dementia (Hattink et al., 2015). For this purpose, the use of innovative technology holds great promise (Egan & Pot, 2016). Innovative technology uses technological tools, like the Internet, phones, and computers, to improve an individual’s functioning and enhance overall well-being (WHO, 2014). Virtual reality (VR), also part of innovative technology, is particularly promising to take the perspective of people with dementia.

Recently, various VR interventions were developed to experience dementia. Alzheimer’s Australia Vic developed a VR tool that simulates thoughts, fears, and challenges of a person living with dementia on a large screen (Alzheimer’s Australia, 2016). Alzheimer’s Research UK launched a VR smartphone app – A Walk Through Dementia – in which the...
viewer takes the perspective of a person with dementia aiming to provide the public a sense of what it is like to live with dementia (Alzheimer’s Research UK, 2016). With the same purpose and target group, the Alzheimer Experience, an online interactive intervention, was developed in the Netherlands (Pot et al., 2012). Finally, the Dutch Into D’mentia, a simulation cabin in which visitors experience typical daily situations of a person with dementia, was developed for informal caregivers and health care professionals (Hattink et al., 2015). A pilot study (N = 33) reported that Into D’mentia was useful, helped to offer better care, and provided understanding of people with dementia (Hattink et al., 2015).

Next to VR, training courses offered via the Internet are a promising method to support informal caregivers (Boots et al., 2014). An Internet course can be followed at home, at any preferred time, and might be easier to accept regarding the stigma associated with seeking professional (mental) help (Pot, Blom, & Willemsen, 2015). Several meta-analyses of randomized controlled trials (RCTs) showed that Internet interventions for people with depression in general were effective (Andersson & Cuijpers, 2009; Andrews, Cuijpers, Craske, Mecoy, & Titov, 2010). Moreover, several systematic reviews of Internet interventions specifically for informal caregivers of people with dementia showed positive effects on caregiver stress and well-being (Boots et al., 2014; Dam, de Vugt, Klinkenberg, Verhey, & van Boxtel, 2016; Hu, Kung, Rummans, Clark, & Lapid, 2015; Jackson, Roberts, Wu, Ford, & Doyle, 2016). For example, a guided self-help Internet course designed to reduce symptoms of depression and anxiety in family caregivers of people with dementia was effective (Blom, Zarit, Zwaftink, Cuijpers, & Pot, 2015), and an Internet-based stress management training significantly reduced caregiver distress (Kajiyama et al., 2013). In particular, multicomponent programs, that combine information and attuned caregiving strategies, were more likely to improve caregiver well-being, compared to single-component programs (Boots et al., 2014).

Based on the promising findings of VR and Internet courses, a simulation-based VR tool that makes use of a 360° dementia simulation movie with a complementing online e-learning course (e-course), called Through the D’mentia Lens (TDL), was developed for informal caregivers to improve understanding of people with dementia. To examine whether TDL is a suitable method for increasing understanding of people with dementia in informal caregivers, a pilot study was conducted. This study focused on the following research questions, in line with the recommendations to pilot-test and optimise new complex interventions by Campbell, Fitzpatrick, Haines, and Kinmonth (2000):

1. Feasibility and acceptability: what are the dropout and attendance rates? How is TDL evaluated by informal caregivers in terms of usefulness, ease of use, satisfaction (Lund, 2001), and acceptability (Proctor et al., 2011)?
2. Impact: what is the impact of TDL on informal caregivers with respect to their person-centred attitude, empathy (primary outcomes), and their perceived burden of care, perceived competence, and quality of the relationship (secondary outcomes)?
3. Are there groups of informal caregivers that especially benefit from TDL, based on their demographics?

**Methods**

**Design**

The feasibility and impact of TDL were studied with a one-group pre-test–post-test design. Participants were asked to fill out a questionnaire one week prior to and three weeks after watching the movie. The questionnaire assessed person-centeredness (PC), empathy, perceived pressure from informal care, perceived competence, and quality of the relationship. The pre-test contained additional questions on demographic variables. The post-test questionnaire contained additional questions about the usefulness, ease of use, satisfaction (Lund, 2001), acceptability (Proctor et al., 2011), and the look and feel of TDL.

**Sample and setting**

Informal caregivers were eligible for the pilot study when they took care of a person with dementia living at home, were Dutch speaking, not visually or hearing impaired, and had sufficient computer skills to follow the e-course. Informal caregivers were excluded if they already participated in the Into D’mentia intervention (see section ‘Intervention’). Informal caregivers of people with dementia were recruited through the case managers of four different care institutes in central and southern regions of the Netherlands. Also, advertisements were published in the newspaper and on social media channels of the Dutch Alzheimer’s Society and the Trimbos Institute. After expressing interest in participating, caregivers were sent an information letter with more details on the study. Eligible individuals willing to participate gave their informed consent for participation (n = 42). The consent procedure was approved by the Ethical Committee of the Trimbos Institute (NR).

**Intervention**

TDL’s 360° simulation movie and e-course were based on Into D’mentia. Into D’mentia is a simulation intervention that makes use of a shipping container furnished as a living kitchen in which sensors and projections are used to help visitors experience what it is like to have dementia (Hattink et al., 2015). A half-day group training with other participants one week after the simulation experience is also part of the intervention. Although Into D’mentia was evaluated positively in a pilot study, the intervention had limitations: it had limited capacity as the single available container had a maximum of 16 individual visits per day and it could only be distributed by truck, which made it rather expensive. Importantly, relatively few informal caregivers visited the simulator in contrast to professionals (Hattink et al., 2015). Therefore, there was a need for the development of a more portable and affordable tool for informal caregivers to experience what is it like to have dementia, resulting in TDL.

The 13-minute simulation movie of TDL, played on a VR device, showed several situations that, according to Droes et al. (2016), accurately reflected a normal day at home of people with dementia from the perspective of a person with dementia: the viewer was the person with dementia (main character). The device reacted to the movements of the viewer, enabling him/her to look around 360°. With that, the
participant encountered limitations, thoughts, and feelings people with dementia could experience during these situations. The limitations were predominantly based on an early stage of Alzheimer’s disease and included confusion, insecurity, suspicion, and disorientation. The movie consisted of different scenes with different levels of interaction (Table 1). The movie was accompanied by an inner voice that reflected the thoughts of the person with dementia, announced via a head- set. The sex of the inner voice corresponded to the sex of the participant. Since experiences with Into Dementia showed that caregivers may react emotional to the simulation, it was decided that the simulation movie could not be seen alone by the caregivers. Therefore, the researcher made an appointment with the caregiver to watch the movie in a health care organisation nearby the caregiver’s home. The researcher had appointments with multiple caregivers on one day. Prior to watching the movie, the participant was prepared for what he/she was going to see and hear by the researcher. Furthermore, the simulation movie was preceded by a short demo video to introduce characters and let the participant get used to the VR headset and its functions. After the movie, the researcher had a short conversation about the participant’s experience and his/her first impression of TDL. Also, the participant received a manual and login code for the e-course.

The e-course, an online course that participants could follow at home, reflected on what had been experienced in the simulation movie in three 20-minute lessons. Its purpose was to strengthen the ability of the participant to empathise with the person with dementia they take care of and provide support to strengthen the relationship between the participant and the person with dementia. Each lesson focused on relevant scenes in the movie (Table 2). By means of exercises with feedback, the different topics of the movie were covered. The participant was free to decide whether he/she completed the lessons all at once or separately. However, with respect to the post-test, the lessons had to be finished within three weeks.

**Data collection**

**Participant demographics**

Demographic variables collected were: age, gender, gender of the person with dementia, education, the relationship with the person with dementia, whether care tasks are shared with others, the diagnoses of the person with dementia, the time since the first symptoms of dementia occurred, and the time since diagnosis.

**Feasibility and acceptability**

To evaluate the feasibility and acceptability of TDL, attendance and drop-out reasons were registered. Additionally, the post-test contained modified statements from the USE-questionnaire to assess TDL’s Usefulness, Satisfaction and Ease of use (Lund, 2001). Examples of statements are: ‘Thanks to TDL I better understand what it is like to have dementia’, ‘TDL was straightforward to execute’ and ‘I would recommend TDL to others’, which could be answered on a 5-point Likert scale ranging from 1 (totally disagree) to 5 (totally agree). TDL’s acceptability was assessed with questions about the content, duration and credibility of the movie, and about the content, duration, clarity and difficulty of the e-course (Proctor et al., 2011). These items could be answered either on a 3-point Likert scale, or with a grade ranging from 0 to 10.

**Primary outcome measures**

To evaluate the impact of TDL on caregivers’ understanding of the person with dementia, person-centeredness (PC) and empathy were evaluated. PC entails ‘valuing a person with dementia as a feeling human being, using their perspective and creating a positive social environment that supports that person’s psychological needs’ (Brooker, 2003, p. 216). Empathy entails the ability to understand the thoughts and feelings of someone else (Singer et al., 2004). These concepts were measured with the ‘PC’ subscale of the Approach to Dementia Questionnaire (ADQ) (Lintern, Woods, & Phair, 2001); translated by Willemse et al., (2015) and the ‘perspective-taking’ (PT) subscale of the Interpersonal Reactivity Index (IRI) (Davis, 1980; translated by De Corte et al., 2007).

The PC subscale of the ADQ measures the extent to which care staff members recognise and respond to people with dementia as unique individuals with the same value as any other person (Lintern et al., 2001). Willemse et al. (2015) showed that 7 of the 11 items of the Dutch subscale loaded strong enough and were therefore used in the analysis (α = 0.83). The items are measured on a 5-point scale ranging from 1 (strongly agree) to 5 (strongly disagree). The final score ranges from 7 to 35, with higher scores corresponding to a more person-centred attitude.

The PT subscale of the IRI measures the tendency of normal functioning adults to adopt the psychological perspective of someone else (Davis, Luce, & Kraus, 1994). This subscale

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**Table 1. The setting and examples of the different scenes of the simulation movie.**

<table>
<thead>
<tr>
<th>Scene</th>
<th>Level of interaction</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>The person with dementia alone</td>
<td>You need to clear away the groceries, but cannot find the fridge. You realise you bought the same groceries again.</td>
</tr>
<tr>
<td>(2)</td>
<td>The person with dementia in interaction with the informal caregiver (the daughter of the person with dementia)</td>
<td>You are confronted by your daughter that the remote control is in the cupboard. Your daughter talks about your situation to someone on the phone.</td>
</tr>
<tr>
<td>(3)</td>
<td>The person with dementia interacting with a group of people</td>
<td>You are confused why people are eating cake, while it is your birthday. You feel the desire to go home although you are already at home.</td>
</tr>
</tbody>
</table>

**Table 2. The topics and content of the different lessons of the e-course.**

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Topic</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Problems associated with dementia</td>
<td>The problems associated with dementia and how people with dementia can experience them. The thoughts and feelings a person with dementia may have had throughout the movie.</td>
</tr>
<tr>
<td>(2)</td>
<td>The communication with people with dementia</td>
<td>How the participants’ behaviour and communication may affect the thoughts and feelings of the person with dementia. How the participant can adjust his/her behaviour and communication style to approach the person with dementia in a positive way.</td>
</tr>
<tr>
<td>(3)</td>
<td>Dementia in social life</td>
<td>How a person with dementia may feel when being in a group of people and the importance of being aware of this.</td>
</tr>
</tbody>
</table>
consists of seven items measured on a 5-point Likert scale ranging from 0 (does not describe me well) to 4 (describes me very well) ($\alpha = 0.71$). Total scores range from 0 and 28, with a higher score corresponding to a higher degree of empathy.

**Secondary outcome measures**

For evaluating the impact of TDL on participants’ perceived pressure from care, perceived competence, and quality of the relationship, three questionnaires were used: the ‘Self-Perceived Pressure from Informal Care’ [Ervaren Druk door Informele Zorg] (SPPIC) (Pot, Van Dyck, & Deeg, 1995); the ‘Trust in Own Abilities’ (TOA) [Vertrouwen in Eigen Kunnen]; Gajic, 2014) and the Dyadic Relationship Scale (DRS) (Sebern & Whitehatch, 2007, translated by Trimbos Institute, 2013).

SPPIC measures the extent to which informal caregivers feel pressure from the care task. This pressure refers to the demands of the caregiving situation compared to the personal interests of the caregiver (Pot et al., 1995). The items are measured on a 5-point Likert scale, with ‘not at all’ and ‘very well’ corresponding to 0 and ‘more or less’, ‘yes’ and ‘yes’ corresponding to 1 (9 items, $\alpha = 0.81$). The total score ranges from 0 to 9, with a higher score meaning a higher degree of care pressure.

The TOA questionnaire inquires to what extent informal caregivers feel capable of performing specific care-related tasks (Gajic, 2014). The scale contains 32 items ($\alpha = 0.97$) divided into three subscales: resilience (RS) (15 items, $\alpha = 0.94$), solution-orientedness (SO) (8 items, $\alpha = 0.90$), and pro-active competence (PA) (9 items, $\alpha = 0.81$). Items are measured on a 5-point Likert scale, ranging from 0 (‘not at all’) to 4 (‘very good’). ‘Not applicable’ could also be marked, which was treated as a missing value. A higher score is associated with a higher perceived competence in taking care of the person with dementia.

The DRS measures positive and negative aspects of family care relationships (Sebern & Whitlatch, 2007). It consists of 11 items, either measuring dyadic strain (DS) (5 items, $\alpha = 0.77$) or positive dyadic interaction (PDI) (6 items, $\alpha = 0.74$) on a 4-point Likert scale. ‘Strongly disagree’ corresponds to 0 and ‘strongly agree’ to 3. Positive items were reversed to calculate the sum scores, so that higher scores indicate higher levels of perceived strain.

**Data analysis**

For the analysis of the feasibility and acceptability, the frequencies, means, and standard deviations of the post-test answers were calculated. To analyse the impact of TDL, either a parametric paired-samples $t$-test or a non-parametric Wilcoxon signed-rank test was executed to test for significant changes. Missing values were considered as follows: if less than 10% of the items were missing, these missing values were substituted with the average value for that subscale. Cohen’s $d$ effect sizes were calculated as $d = (M_1 - M_0)/SD_0$ (Lipsey & Wilson, 1993). Small effect sizes range from 0 to 0.32, moderate effect sizes from 0.33 to 0.55, and large effect sizes range from 0.56 to 1.2 (Lipsey & Wilson, 1993). Univariate linear regression analysis was used to examine whether specific groups of participants especially benefited from TDL. For this, significant effect sizes were used as dependent variable and the demographic variables as prognostics factors. If univariate analysis revealed multiple prognostics factors, these factors were used in multivariate analysis. SPSS 22 was used for all analyses.

**Results**

**Participant demographics**

In total, 72 people were interested in participating in the study (Figure 1). Thirty-five of them were not included as they: did not meet the inclusion criteria ($n = 15$, of which nine were not an informal caregiver, five took care of a person with dementia who was already institutionalised, and one already participated in Into D’Mentia); refused to participate after receiving more information about the study ($n = 5$) or did not respond after receiving the information ($n = 10$). Forty-two people completed the pre-test and started TDL. Thirty-five of them completed TDL and post-test (83%). Of the seven participants who dropped out, two did not fill out post-test because the person with dementia passed away, three participants did not follow the e-course and two participants did not respond to the post-test for unknown reasons.

The mean age of the participants who completed the pre-test and post-test of the study was 55.1 years (Table 3). The majority of participants was female (77%), had secondary (54%) or high (46%) education, and was a child of the person with dementia (66%). Sixty per cent noticed the first symptoms longer than two years ago. Fifty-one per cent of the persons with dementia were diagnosed with Alzheimer’s disease.

The mean age of the participants who dropped out during the study was 66.7 years, which was significantly higher than the completers. Other demographics did not significantly differ from the completers.

**Feasibility and acceptability**

**Usefulness**

Most participants stated that TDL was useful, made them feel more effective and more confident about their care qualities
Table 4. Usefulness, ease of use, and satisfaction of TDL.

<table>
<thead>
<tr>
<th>Usefulness</th>
<th>Mean (SD) (N = 35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDL is useful</td>
<td>4.03 (1.04)</td>
</tr>
<tr>
<td>TDL helps to be more effective</td>
<td>3.60 (1.01)</td>
</tr>
<tr>
<td>TDL helps to be more productive</td>
<td>3.17 (1.23)</td>
</tr>
<tr>
<td>TDL gives more control over my activities</td>
<td>3.06 (1.19)</td>
</tr>
<tr>
<td>TDL helps to get the things I want done easily</td>
<td>2.69 (1.30)</td>
</tr>
<tr>
<td>TDL makes me feel more confident of my care</td>
<td>3.74 (1.12)</td>
</tr>
<tr>
<td>TDL helps me think what I have to do</td>
<td>4.06 (0.94)</td>
</tr>
<tr>
<td>TDL helps me make my decisions</td>
<td>3.83 (1.22)</td>
</tr>
<tr>
<td>TDL improves my understanding of my care</td>
<td>4.14 (0.94)</td>
</tr>
</tbody>
</table>

Ease of use

With regard to the ease of use, TDL was evaluated positively (Table 4). Most participants totally agreed that TDL was easy to execute, straightforward, and user-friendly. The majority understood what they had to do and thought that what they had to do was not difficult at all.

Satisfaction

In general, the participants were satisfied with the intervention (3.97 out of 5.00) (Table 4). The majority of the participants would recommend it to others (4.40).

Acceptability

The scores on the simulation movie and its separate scenes were relatively positive (8.03, 8.00, 8.17, and 7.66 out of 10, respectively) (Table 5). During the movie, most participants thought they were able to empathise with the person with dementia (main character) to a large extent (86%) and found the movie realistic (89%). Most participants thought that the duration of the movie was exactly right (80%).

The mean grade of the e-course was 7.66. Thirty participants found that the e-course was a valuable addition to the movie (86%). The open answers revealed that this was, among others, because the participants ‘became more aware of the perception of the person with dementia’ and it ‘reflected on their own behaviour towards the person with dementia’. Most participants thought that the e-course had the right amount of lessons (86%) and that the duration of the separate lessons was right (80%). The assignments, feedback, and texts were clear (77%; 71%; 80%) and had a good level of difficulty (97%; 94%; 97%).

Impact

Primary outcome measures

Considering the primary outcome measures, the PT subscale of the IRI showed a significant increase between pre-test and post-test scores (t(34) = 2.91, p = 0.006; Table 5), indicating that participants were better able to empathise with the person with dementia compared to before TDL. The effect size was moderate (d = 0.42). The participants’ PC did not increase.

Secondary outcome measures

Regarding the secondary outcomes measures, the total score on the TOA questionnaire and its subscales RS and PA showed significantly higher scores at post-test compared to pre-test (Table 6). This indicates that after TDL, participants felt more competent in taking care of the person with dementia (t(27) = 2.96, p = 0.007), felt more resilient (t(34) = 3.00, p = 0.005), and more pro-active (t(25) = 2.14, p = 0.043). The effect sizes of TOA in total (d = 0.36) and the PA subscale (d = 0.35) were moderate. The effect size of the RS subscale was small (d = 0.32). The scores on the SO subscale did not change.

In addition, participants experienced significantly more positive interactions in their relationship with the person with dementia, as the score on the PDI subscale of the DRS significantly decreased (t(34) = 4.23, p = 0.000), with a large effect size (d = −0.62). The scores on the total DRS and on the DS subscale did not significantly change. Also, the participants’ SPPIC did not significantly change.
In this pilot study the feasibility, acceptability, and impact of TDL (360° simulation movie and e-course) for informal caregivers were evaluated.

Generally, the results indicate that TDL is feasible and acceptable for informal caregivers. First, low drop-out rates were found: 83% of the participants completed TDL, including the post-test. The high scores on ease of use indicate that TDL is a user-friendly intervention. TDL was evaluated successful in helping informal caregivers better understand what it is like to have dementia and to provide insight in the perception of the person with dementia. Most participants thought they could empathise with the person with dementia in the movie.

Regarding impact, after TDL the participants reported better ability to empathise with the person with dementia, more confidence in their care task (attributed to RS and PA), and more positive interaction with the person with dementia. These outcomes suggest that experiencing dementia has impact on a variety of facets of the care task. Interestingly, the RS of secondary educated participants increased more compared to higher educated participants. RS in this study referred to the ability to remain a positive attitude towards the person with dementia and to keep thinking positively about the care task despite setbacks. Potentially, the tips and assignments of the e-course were more attuned to secondary educated people. The fact that this group especially benefitted from TDL is notable, as online interventions often predominantly support higher educated people (Bolier et al., 2013). TDL might thus be a valuable addition to the interventions that can support secondary educated caregivers. In addition, the PA, i.e. the tendency to initiate action and to ask or search for help if needed, of participants who took care alone improved more compared to those who shared the care task. Possibly, TDL, or the e-course in particular, mainly gave the former group the insight that taking care of the person with dementia can be overwhelming and that asking for help is necessary, whereas the latter group was already accustomed to this situation.

This study was unable to detect improvements in the primary outcome measure PC. Possibly, the specific items of ADQ did not match the way TDL aimed to improve PC. For example, the item ‘there are many things people with dementia do’ was no major focus in the simulation movie, nor in the e-course. The usage of another person-centred attitude scale should be reconsidered in further research.

### Discussion

#### Groups of informal caregivers that especially benefitted from TDL

Analysis showed that effect size of RS could be predicted from educational level \( F(1, 34) = 5.34, p = 0.027 \), indicating that the impact of TDL on RS was higher for secondary educated participants compared to higher educated participants (Table 7). The mean score of the secondary educated participants on RS increased from 34.83 (SD = 11.69) at pre-test to 40.78 (SD = 11.81) at post-test \( (d = 0.51) \), while the mean scores of the higher educated participants were 36.20 (SD = 10.88) and 36.94 (SD = 8.12), respectively \( (d = 0.07) \). Furthermore, the effect size of PA could be predicted from whether the care task was shared with someone else or not \( F(1, 25) = 7.67, p = 0.011 \), indicating that TDL had a greater impact on the proactive competence of participants who did not share the care task, compared to those who did share the care task. The mean score of the participants who took care of the person with dementia alone increased from 18.15 (SD = 4.68) at pre-test to 24.00 (SD = 8.44) at post-test \( (d = 1.25) \), the mean scores of the participants who shared the care task on PA were 21.02 (SD = 5.03) and 21.79 (SD = 5.05), respectively \( (d = 0.15) \).

#### Table 5. Acceptability of the simulation movie and the e-course.

<table>
<thead>
<tr>
<th>Simulation movie</th>
<th>N = 35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade movie in general</td>
<td>Mean 8.03 (SD 1.07)</td>
</tr>
<tr>
<td>Grade first scene (person with dementia alone)</td>
<td>Mean 8.00 (SD 1.24)</td>
</tr>
<tr>
<td>Grade second scene (person with dementia with informal caregiver)</td>
<td>Mean 8.17 (SD 1.10)</td>
</tr>
<tr>
<td>Grade third scene (person with dementia in a group (birthday party))</td>
<td>Mean 7.66 (SD 1.59)</td>
</tr>
</tbody>
</table>

**Table 7.** Impact of TDL on RS was higher for secondary educated participants (Table 7). The mean score of the secondary educated participants on RS increased from 34.83 (SD = 11.69) at pre-test to 40.78 (SD = 11.81) at post-test (\( d = 0.51 \)), while the mean scores of the higher educated participants were 36.20 (SD = 10.88) and 36.94 (SD = 8.12), respectively (\( d = 0.07 \)). Furthermore, the effect size of PA could be predicted from whether the care task was shared with someone else or not (\( F(1, 25) = 7.67, p = 0.011 \)), indicating that TDL had a greater impact on the proactive competence of participants who did not share the care task, compared to those who did share the care task. The mean score of the participants who took care of the person with dementia alone increased from 18.15 (SD = 4.68) at pre-test to 24.00 (SD = 8.44) at post-test (\( d = 1.25 \)), the mean scores of the participants who shared the care task on PA were 21.02 (SD = 5.03) and 21.79 (SD = 5.05), respectively (\( d = 0.15 \)).
Limitations

There are some limitations to the study. First regarding the design of the study, the impact of TDL cannot be attributed to the intervention with certainty. The one-group pre-test–post-test design lacked a control group. Other factors, like the participants’ personal circumstances, for example deterioration in the functioning of the person with dementia and involvement of professional caregivers, such as a case manager or social worker, could have had an effect on the outcomes as well. Also, the study had a small sample size. Therefore, the small changes found between the pre- and post-scores on, for example, the PC subscale of ADQ and the SPPIC questionnaire, may be insignificant. Finally, testing effects might have occurred; filling in the pre-test might have influenced the way the participants filled in the post-test (i.e., carry-over effect) (Shaughnessy, Zechmeister, & Zechmeister, 2006, p. 316). However, a pilot study with a small one-group pre-test–post-test design is the suitable first step in intervention development (Campbell et al., 2000).

Improvements in the secondary outcome measures perceived pressure from informal care, SO, and DS in the relationship with the person with dementia, were also not found. Thus, TDL did not enhance outcomes that were no main focus of TDL.

Recommendations

This research indicates that TDL can support informal caregivers in their care task. To realise its full potential, several recommendations given for innovative technology can be considered (Egan & Pot, 2016). First, TDL should be affordable and accessible for informal caregivers. Regarding affordability, the current study suggests that TDL can be useful without involvement of (paid) care professionals. Regarding accessibility, it is recommendable to inform informal caregivers about TDL at the beginning of the dementia care process, for institutionalised persons with dementia (Gajic, 2014), respectively, and the Dutch translation of DRS is not validated yet. This can lead to lower questionnaire reliabilities. However, all Cronbach’s alphas scored above the cut-off value of .70, which is acceptable according to George and Mallery (as cited in Glim & Glim, 2003).

Third, the study might have a sampling bias. Participants were mainly recruited via case managers who could have selected particular informal caregivers. However, also open and written advertisements were published on web pages and social media, with the potential to reach a broader ‘range’ of informal caregivers, although still only online caregivers.

The large portion of female participants might have influenced the results of the study. This particular concerns the results found for PT, as females might be better able to empathise with others (Van der Graaff et al., 2014). Although gender was no prognostic factor for the effect size of PT subscale, this might be due to the small amount of males included in the study.

Finally, because this study looked at the impact of the intervention as a whole, impact of the separate intervention components (the simulation movie and the e-course) is unknown. However, most participants felt that the e-course had added value to the intervention. Thus, it seems likely that the combination of the VR movie and the e-course makes TDL powerful. Additionally, a short conversation directly after watching the simulation movie was part of TDL, which could have attributed to TDL’s impact as well.

Table 6. Results on person-centeredness, perspective-taking, Self-Perceived Pressure from Informal Care, resilience, solution-orientedness, pro-active competence, total dyadic relationship, dyadic strain, and positive dyadic interaction.

<table>
<thead>
<tr>
<th>Questionnaire, subscale</th>
<th>N</th>
<th>Pre-test Mean (SD)</th>
<th>Post-test Mean (SD)</th>
<th>Dif.</th>
<th>Sig.</th>
<th>g</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary outcome measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADQ Person-centeredness</td>
<td>35</td>
<td>29.29 (3.91)</td>
<td>30.06 (3.10)</td>
<td>0.77</td>
<td>.188</td>
<td>–</td>
</tr>
<tr>
<td>IRI Perspective-taking</td>
<td>35</td>
<td>15.03 (4.57)</td>
<td>16.94 (4.66)</td>
<td>1.91</td>
<td>.006</td>
<td>0.42</td>
</tr>
<tr>
<td><strong>Secondary outcome measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPPIC Total</td>
<td>35</td>
<td>5.00 (2.62)</td>
<td>4.83 (2.54)</td>
<td>0.17</td>
<td>.556</td>
<td>–</td>
</tr>
<tr>
<td>TOA Total</td>
<td>27</td>
<td>74.65 (18.17)</td>
<td>81.25 (18.04)</td>
<td>6.61</td>
<td>.007</td>
<td>0.36</td>
</tr>
<tr>
<td>Resilience</td>
<td>35</td>
<td>35.46 (11.18)</td>
<td>39.03 (10.34)</td>
<td>3.57</td>
<td>.005</td>
<td>0.32</td>
</tr>
<tr>
<td>Solution-orientedness</td>
<td>31</td>
<td>19.25 (5.52)</td>
<td>19.59 (6.26)</td>
<td>0.34</td>
<td>.460</td>
<td>–</td>
</tr>
<tr>
<td>Pro-active competence</td>
<td>26</td>
<td>19.90 (5.25)</td>
<td>22.42 (5.96)</td>
<td>2.54</td>
<td>.043</td>
<td>0.35</td>
</tr>
<tr>
<td>DRS</td>
<td>35</td>
<td>15.46 (3.79)</td>
<td>14.60 (4.76)</td>
<td>0.86</td>
<td>.157</td>
<td>–</td>
</tr>
<tr>
<td>Dyadic strain</td>
<td>35</td>
<td>5.66 (3.02)</td>
<td>6.31 (3.07)</td>
<td>0.65</td>
<td>.082</td>
<td>–</td>
</tr>
<tr>
<td>Positive dyadic interaction</td>
<td>35</td>
<td>9.80 (2.46)</td>
<td>8.29 (2.66)</td>
<td>1.51</td>
<td>.000</td>
<td>–0.62</td>
</tr>
</tbody>
</table>

*Approach to Dementia Questionnaire (ADQ); Possible scores range from 7-35. Higher scores indicate a more person-centred attitude.  
†Interpersonal Reactivity Index (IRI). Possible scores range from 0 to 28. Higher scores indicate higher tendencies to adopt the perspective of someone else.  
‡Self-Perceived Pressure from Informal Care (SPPIC). Scores can range between 0 and 9, with higher scores indicating more self-perceived pressure.  
§Trust in Own Abilities (TOA). Possible score ranges are, respectively: 0–128, 0–60, 0–32, 0–36. Higher scores correspond with greater resilience, more solution-orientedness, and more pro-active competence.  
©Dyadic Relationship Scale (DRS). Possible scores of the total and two subscales are, respectively: 0–128, 0–60, 0–32, 0–36. Higher scores correspond with more perceived strain in the relationship.  
††Dif. = difference between pre-test and post-test.  
†‡Sig. = significance value. Results are significant if p < .005.  
§§d = effect size of t-test; a negative effect size on PDI means improvement from pre-test to post-test, in all other scales a positive effect size means improvement.

Table 7. Prognostic factors in a univariate regression model for resilience and pro-active competence.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Prognostic factor</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>Sig.</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resilience</td>
<td>Education*</td>
<td>-0.47</td>
<td>0.20</td>
<td>-0.37</td>
<td>.027</td>
<td>.139</td>
</tr>
<tr>
<td></td>
<td>Sharing care</td>
<td>-1.02</td>
<td>0.37</td>
<td>-0.49</td>
<td>.011</td>
<td>.242</td>
</tr>
</tbody>
</table>

* The secondary educated participants were compared with higher educated participants.  
‡ The participants who took care of the person with dementia alone were compared with the participants who shared the care task.

This research indicates that TDL can support informal caregivers in their care task. To realise its full potential, several recommendations given for innovative technology can be considered (Egan & Pot, 2016). First, TDL should be affordable and accessible for informal caregivers. Regarding affordability, the current study suggests that TDL can be useful without involvement of (paid) care professionals. Regarding accessibility, it is recommendable to inform informal caregivers about TDL at the beginning of the dementia care process, for
example via physicians or case managers, so that caregivers can benefit from the gained insights as long as possible. This suggestion is also in line with another statement by Egan and Pot (2016), namely that innovative technology should be integrated with existing services. Furthermore, innovative technology should account for disease progression (Egan & Pot, 2016). In its current form, TDL focuses solely on the first stage of Alzheimer’s disease. Potentially, the development of additional scenes and lessons focussing on later stages and other forms of dementia would further enhance the use of TDL. Until then, it is recommendable to inform informal caregiver of people with dementia about the existence of TDL in an early stage of the disease.

The suitable next step would be a RCT with wait-list control group (Campbell et al., 2000; Cunningham, Kypri, & McCambridge, 2013) to further examine the effectiveness of TDL. Also, it should be investigated whether the results of this study last over time, as no follow-up measurements were performed here. Finally, it is recommended to explore whether TDL is also feasible and effective for other target groups, such as volunteers, care professionals or other people who need to interact with people with dementia in their job, like police-men and bus drivers, educational institutes, and health care facilities. For that purpose, the content of the e-course and potentially also the movie need to be adjusted. In conclusion, it seems that VR can create understanding of and insight in the perception of people with dementia and therefore, it deserves further attention from developers, researchers, and other relevant stakeholders.

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