# VITA: Towards Supporting Volunteer Interactions with Long-Term Care Residents with Dementia

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## ABSTRACT

Volunteers are an important resource at long-term care homes because they can supply services, such as engagement activities, that over-burdened care staff struggle to provide. However, volunteers without sufficient training are often challenged in responding to dementia-linked behaviors, which can lead to frustrating difficulties during interaction. Additionally, short-staffed care homes have difficulties in training and maintaining volunteers. To better support volunteers in providing engagement activities for people with dementia without a high training burden, we created VITA, a tablet-based system that supplies carefully designed profiling and guidance using our dementia-appropriate engagement activity kit. Our evaluation indicated that the instructional guide supplied by VITA significantly improves volunteers' ability to facilitate engagement activities with people with dementia, approaching the level of engagement achievable by professional therapists.

## Author Keywords

Engagement activity; tablets; dementia; nursing homes; volunteers; dementia care.

## ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## INTRODUCTION

Volunteers can play an important role in nursing homes – they serve as a source of extra help because they provide services that understaffed nursing homes find difficult to supply [14]. Over the years, in many countries, volunteers have been recruited for a variety of service programs, such as reminiscence activities (Hong Kong) [4], friendly visiting (Canada) [12], and art activities (US) [24].

'Engagement activities' is an occupational therapy term for the activities provided in these types of service programs. The term is defined as any activity that can provide social and cognitive stimulation for residents, with the goal of improving psychosocial wellness. For people living with dementia, these engagement activities are critical, because the impairments stemming from the disease result in the loss of the ability for the person to seek out, plan for and engage in such activities on their own [8]. Nursing homes strive to supply such activities because studies show that the lack of such engagement can lead to the increase of undesirable behavior [5, 26], apathy [23], and depression [3] among people with dementia (henceforth referred to as "clients").

However, using volunteers in dementia care presents its own set of challenges. Volunteers are often inexperienced in responding to dementia-linked behaviors [17, 33, 39], and they are generally unfamiliar with the individual needs of the client [12,15,17,18], which can lead to frustrating difficulties during interactions [12,15]. These challenges can demotivate volunteers, who are unlikely to return as a result of disappointing interactions [13,15]. Consequently, nursing homes are required to invest already scarce resources to specially train volunteers [30] to interact with individuals with dementia.

Thus, we were motivated to address the problem of improving volunteer expertise when supplying engagement activities to clients, while minimizing burden to the long-term care home. To understand the practice of volunteering within the organizational constraints of the nursing home, we partnered with a local nursing home to observe and participate in volunteer activities. We also studied the nature of expertise among occupational and physical therapists who supply engagement activities, in order to identify appropriate ways to improve the expertise of volunteers. Our studies suggested that we might improve the level of expertise of volunteers by pre-packaging activities and client-customizing instructions for volunteers.

As a result, we developed VITA: Volunteer Interactions via Tablet-based Activities. It is comprised of a client Profile module, an Activity Kit module and a personalized Activity Guide. The Activity Kit contains a set of pre-packaged activities, each featuring a commercially available app with

accompanying instructions for volunteers to facilitate client engagement with the app.

For example, if a client named Karen enjoys crafts, an employee of the nursing home can use VITA to create a tailored Profile for Karen that includes these activities. Then, when a new volunteer arrives and is assigned to engage Karen, the volunteer is given a tablet containing Karen's simplified biography and instructions on how to interact with her using these activities. Since Activity Guides are unique to each client, volunteers are more effective and time is saved for both volunteers and nursing home staff.

Using a mixed-methods study, we evaluated the effect of volunteers using VITA's Activity Guide on engagement of clients. We compared engagement outcomes against a control condition with no facilitation instructions, and also against the ideal scenario of one-to-one facilitation by an experienced therapist.

We found that volunteers using VITA's Activity Guide could facilitate engagement at significantly higher levels compared to those in the control condition. In addition, these results were comparable to therapist-interaction outcomes, with a stronger effect observed when used with clients with more severe dementia. Our findings indicate that this approach of providing volunteers with client biographical information that is supplemented with facilitation instructions enhances client engagement.

The contributions of this paper include the following:

1) Qualitative contextualized studies to derive user requirements for a computer-supported program for volunteers.
2) The provision of VITA, a tablet-based system that enables volunteers to facilitate engagement activities for individuals with dementia without a high training burden. VITA's central proposition is pre-packaged, volunteer-friendly activities that are easily customizable to client needs.
3) An empirical evaluation that shows the effectiveness of VITA, with findings that point to the importance of analysis of outcomes by dementia severity.

## RELATED WORK
In this section, we review computer-supported ways to enhance engagement in dementia, and look also at volunteer-specific research.

In dementia care, there exists a large body of work focused on supplying clients with engagement activities [e.g. 14,29]. The key guideline derived from these physical engagement studies is to offer activities are customized to the individuals – by abilities [34], personal interests [22] or even personality [22]. Although such methods are possibly applicable to digital activities, there were no previous studies that have attempted customization of computer-based activities for engagement.

Digital apps have been studied as cognitive training programs [e.g. 26], but not as engagement activities that are targeted toward psychosocial wellness. Other studies, using custom-built multimedia devices for engagement, show that devices can be very effective as a focal point when interacting with people with dementia. Depending on the content it supplies, the device can help improve conversation via the supply of personal history [12] or cohort-based prompts [1], or improve the caregivers' understanding of the personality and preferences of the person with dementia via holistic health records [25], multimedia presentations [37], personalized art installations [35] and personal interactive jewelry [36].

While these devices are useful for clients and their caregivers, we could not directly apply them to the goal of this paper: improving volunteer expertise when interacting with clients. The studies mentioned above are targeted at clients and their primary caregivers (e.g. family and care workers), who are often already familiar with dementia care. We are not aware of any digital engagement artifacts designed specifically for use by volunteers, although volunteers may have been incidental participants in some cases [25,37]. Therefore, we expanded the scope of the literature review to volunteer training programs.

### Training Programs for Volunteers
From our review of previous studies, we saw that the information requirements for volunteers have some similarities with primary caregivers, but also some important differences. Both groups share a need for better understanding of dementia itself [4,12,15,31]. Primary family caregivers want information on burden coping mechanisms [31,32] and alternative care services [32,33] for their loved ones, while volunteers have thus far expressed none of these information needs. Instead, they have expressed a variety of requests such as access to biographical history, preferences, recently conducted activities and even medical histories of the individuals with dementia [12,15,18]. The studies suggest that they want this information in order to build empathy and to connect with the client [15,18]. It appears that due to their unfamiliarity with the client, volunteers have information needs that revolve around basic 'getting-to-know-you' content.

Interestingly, although quite a few studies have reported what volunteers ask to know, to our knowledge there have been no studies that implement the delivery of such information, or subsequently assess the effects of sharing such information on volunteer efficacy. Thus, our first research question was to determine the nature and type of biographical information that a volunteer-support system should supply, in order to increase a volunteer's ability to engage with clients.

Another reported way to enhance the ability of volunteers to engage clients is to supply training - often a combination of knowledge about the disease and coping methods and information on conducting the target activity. Many studies

report on the success of such activity-specific training programs [e.g. 4,17,18], indicating that volunteer training is a reliable method to improve volunteer efficacy.

At the same time, these studies report ongoing issues in the *supply* of volunteer training. They suggest that further work is needed to reduce volunteer drop-out [29], improve volunteer commitment [4], and reduce the duration of training [12]. Furthermore, some studies point out the need for creating a system for ongoing support post-training, via volunteer supervisors [14,24]. These difficulties are consistent with research on the difficulties of long term care facilities in general, where volunteer recruitment and management requires a significant use of resources [14,15,30].

Overall, the related work indicates that there is a research gap in knowing what type of information to offer volunteers to improve their interaction with clients. At the same time, there is a need to ensure that solutions implemented to support volunteers do not further strain the ability of long-term facilities to provide such systems.

## DESIGN AND DEVELOPMENT OF VITA

As HCI researchers, we approached this challenge as an example of task support research. What behaviors should volunteers have in order to improve their efficacy with clients? How do experts, such as occupational therapists, behave with clients? Can we identify computer-supported methods to improve the ability of volunteers to attain these same behaviors? How do we design a system to minimize the maintenance burden to care staff?

To answer these questions, we first conducted an exploratory participant-observer [21] study at a local care home to gather insight into the practice of volunteering and volunteer management. Based on the findings of the first study, we drafted initial system concepts. We brought these concepts to a focus group consisting of long-term care staff with experience in supplying engagement activities. The feedback of the participants expanded our understanding of therapeutic expertise, and in turn informed our user requirements for the system.

### Participant-Observation Study

We partnered with a 250-bed, subsidized long-term care facility in Singapore. As with half of nursing homes in this country the care center is run by a voluntary welfare organization[1] [39]. Detailed findings of this study are documented elsewhere [15], so we only summarize the key points below.

### Strained Resources

We affirmed the aforementioned link between care staff shortage and the role of volunteers in a nursing home. At this nursing home, there was approximately 1 care staff to

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[1] The remaining half are private homes

every 8 residents, which is far below government guidelines of 1 staff to 3.5 residents [39]. To alleviate the burden, the home's Volunteer Coordinator arranges an average of 2 group volunteer visits a month, each consisting of approximately 10–20 persons from a large variety of schools and welfare organizations.

### Makeup of volunteers

Although this number was not small, we also learnt that the pool of volunteers was characterized by constant shifts in number and abilities. Almost all the volunteers were single visit volunteers, coming from various social organizations, companies and schools. The few long-term volunteers we encountered performed instrumental services, such as haircuts and administration. The home's Volunteer Coordinator explained, "*A regular commitment over a year is extremely difficult to negotiate with our partner schools. They have their own schedules too, so we just accept when we can, and try to request for help when we need it.*"

### Types of engagement activities

Our next observation was that the physical constraints of the home strongly influenced the types of engagement activities the staff felt they could undertake. As with many long-term care facilities in metropolitan Asia, limited space was an issue. The home had shifted two years ago from a 5-story building with garden space to a new 9-story building with scarce surrounding land. With the new layout, staff had to adapt activities to involve fewer residents at one time, take up less space, involve less equipment, and require less movement between floors for residents with mobility difficulties..

### Challenges of tablet-based activities

One example of a possible solution was the introduction of 'tablet therapy' as an engagement activity. The value of tablet technology in this setting comes from it being a single piece of equipment that has many interaction options, is portable, and has the potential for promoting interactions in smaller groups. We observed and interviewed single-visit volunteers with tablets who visited residents with dementia. While volunteers generally found the tablet to be a useful device for mediating conversations with the clients, they also experienced awkwardness and difficulty with the communication abilities and the dementia-linked behaviors of the clients they met. Many of them were also at a loss at how to engage these clients.

As a result of this study, we identified a design opportunity to support volunteers' information and expertise needs via the use tablets, due to the following reasons: 1) tablets were already in use, and volunteers found it useful to help facilitate activities with clients; 2) unlike physical activities, which often require an assortment of equipment and larger activity areas, tablets allow a wide variety of applications, catering to different interests, to be stored on a compact device. It also requires much less space to use.

**Focus Group Study**
To better understand how to design tablet-based engagement activities, we conducted a focus group study with long-term care workers who were familiar with organizing engagement activity programs with volunteers.

*Participants*
We recruited an occupational therapist, a physiotherapist, a long-term care nurse, and a community care therapist (age mean=28.2, all female, average years in long-term care = 3.8). One co-author and a research student facilitated the focus group.

*Materials and Method*
Materials used during the focus group sessions were video footage of a tablet therapy session, early workflow sketches, and commercially available apps for dementia activities. We chose CleverMind [40] and GreyMatters [41] from the App Store's top 10 recommendations as they are specifically designed for clients, offering biographical information and a variety of game and engagement content.

*Focus Group Results*
The participants found that CleverMind and GreyMatters seemed to have cognitive game content (e.g. card matching) that suited the needs of clients, but they still would not choose to use such apps to facilitate engagement in their work due to the following reasons.

Firstly, the participants indicated that the content of the dementia-specific apps were too culture-specific. For example, CleverMind's music content was exclusively comprised of American music from the 1950's, which may not be familiar to local clients. Therapists explained that they often favor local music, sung in local dialects, as stimuli for engagement.

Secondly, the cognitive game content of the apps did not pre-customize the activities to the client's abilities. Therefore, some trial and error may still be needed in order to find the appropriate game and game level for a particular client. Participants mentioned that volunteers who are unfamiliar with either dementia or the client may interpret errors made during this search process as failures. Instead the physiotherapist suggested that volunteers be given 'booster activities', activities that are already known to succeed with each client, in order to boost the volunteer's confidence and quickly capture the client's attention.

When queried about how they think volunteers should use apps with clients, participants pointed out that many freely available apps can be re-purposed. In essence, activities around existing apps can be modified to become dementia-friendly. As mentioned by the occupational therapist, *"Most tasks can be broken into smaller tasks - with some prompting and cueing from a facilitator, often the clients can still complete these tasks."* For example, a client's self-dressing activity can be broken down into steps by laying out the clothing in the order of dressing on a bed. In the same way, the operation of an app can be presented in smaller steps in order to facilitate client participation and engagement. For example, using a coloring book app can be broken into the steps of choosing a color, applying a color, and choosing another color.

It was a new insight for us that even if an app were not designed to be dementia-appropriate, it could be re-purposed by presenting it to the client in smaller, more achievable steps. The occupational therapist explained further that this strategy is called 'activity modification' [34] and is often applied to physical engagement activities for clients. The basic premise of activity modification is that a therapist uses her familiarity with the client's abilities and interests to adjust an activity to match the level of remaining ability.

**From Insights to User Requirements**
The discovery of activity modification was a key insight on how to support non-expert activity facilitators such as volunteers. To enable these volunteers to modify and deliver activities, they should be able to 1) know a client's abilities and interests, 2) select appropriate apps and 3) provide app-based activities according to the client's abilities. Each of these user requirements generated sub-tasks that had to be addressed before we could meet these needs.

Firstly, information about a clients abilities and interests is usually, but not always available in therapy reports and daily interaction logs in the nursing home. However, these reports are not suitable for volunteers to use as they contain professional terms and sensitive health data, such as the patient's mental status and critical medical events. Therefore, another related design requirement of a support system is that it should be able to present the appropriate amount of information about the client, shown in ways that can be quickly understood.

Secondly, one way to enable volunteers to have appropriate apps is to pre-identify a set of dementia-friendly applications, preferring those that are cohort- or culture-appropriate. We also saw that the app re-purposing approach had the advantage of less maintenance via the utilization of already available content as existing apps may provide a ready supply of free and updated content for app-based modified activities. Despite these potential benefits, there remained a challenge to identify methods to effectively repurpose these apps. There is no previous dementia care research on how to do this for digital activities. Thus, there was an additional task of developing a replicable approach for selecting good candidate apps, and then modifying the app-based activities via the ability-specific instructions.

Thirdly, even if a volunteer were given the profile information of a client, and a collection of dementia-friendly apps, s/he may not know how to utilize this information to select the appropriate app and use it in an effective way to interact with the client. For example, if a
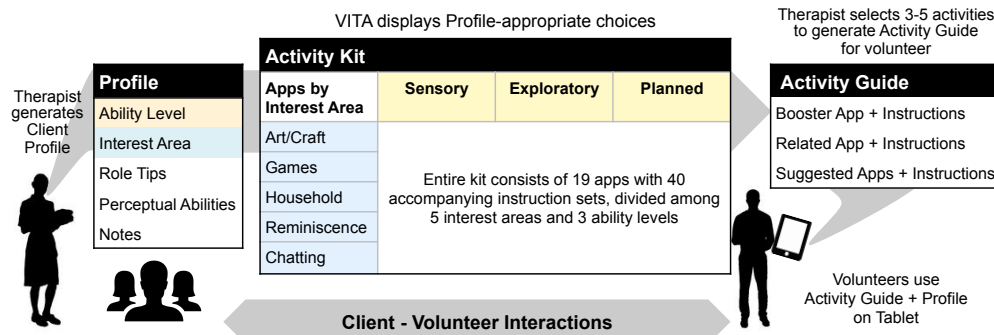
**Figure 1: VITA System Components: Profile (left), Activity Kit (center, with Apps & Instructions) and Activity Guide (right)**

volunteer knows that a client has low ability to communicate, will she be able to select and present content in a way that is stimulating but does not necessitate verbal response?

Thus, this led us to the third sub-task: not only should the client's profile should be provided, it should also be *pre-translated* into specific instructions on what apps to use and how to use the app in a way that caters to the remaining abilities of the client.

**IMPLEMENTATION**

To meet these requirements, we conceptualized the VITA prototype (see Fig. 1) as having 3 linked components:

1. Client Profile: This contains a set of simplified and glanceable biography of a client for volunteers to read before the engagement activity. This includes the client's overall ability level (e.g. *Exploratory*), interests (e.g. *Art/Craft,*) detailed perceptual abilities (e.g. *Hearing: fair*), volunteer role description (e.g. *Give instructions one step at a time*) and notes (e.g. *Prompt often*)

2. Activity Kit: This contains pre-packaged activities for volunteers. It has two major components.

2.1 The first component is a grid of apps categorized by client ability levels and interests.

2.2 The second component is the accompanying instructions on how to use a particular app when interacting with a client of a particular ability level.

3. Personalized Activity Guide: This contains the overall plan on how to interact with a particular client during an engagement session (e.g. *1. Introduce yourself, 2. Begin with "Polly Bubble Tea Maker": Let the resident…*). See bottom of Table 1 for the full example.

In our system, the therapist fills a web-based form so that the system can generate the client's Profile. Based on the stated ability level and interest(s), the system recommends a shortlist of interest- and ability-matched apps from the Activity Kit. Therapists select 3-5 of these activities, and these become the Activity Guide as a visit plan for the volunteer. The volunteer uses all three components to facilitate engagement activities with clients.

**Activity Kit Development**

To ensure the activity kit suits the needs of clients, we collaborated with an occupational therapist with more than 3 years of experience in creating and delivering engagement activities to form the development team. The following section describes the procedure for developing the kit.

First, we defined the types of interests and abilities that the contents of the Kit would cater for. For interest areas, we selected 5 interest areas based on previous literature [16]: reminiscence, household-linked activities, games, arts and crafts, and chatting,

For ability categorization, we looked at several available tools that can used to categorize clients ability levels (e.g., Allen's Cognitive Levels), and selected Pool Activity Levels (PAL) [42] as it is a well-established framework and has been previously utilized by other customized engagement activity programs [e.g.17,33]. PAL describes four ability levels. These are activities that require planning (Planned), activities that are only exploratory in nature (Exploratory), activities that are selected for their sensory (sound, sight) qualities (Sensory), and activities that trigger reactions (Reflexive). We excluded Reflexive activities because these require the use of direct physical stimulation to raise self-awareness levels of clients, and were therefore less appropriate for volunteers. Examples of these activities are stroking a person's arm or food tasting, which can be risky or too invasive for non-experts [28], as clients at this level of severity are often frail or uncommunicative. Combining the chosen interests and ability levels, we had a grid of 5 (interests) x 3 (ability levels) in our Activity Kit.

Next we looked for apps that would fit into this grid. We reviewed more than 80 apps and shortlisted 38 apps. With these, we began drafting app-specific facilitation instructions based on the abilities of the client in each ability level (Fig. 1, center). With the collaborating therapist, we wrote instructions to help volunteers understand *how* to modify tasks, *when* to prompt for responses, and *what* overall goal of the activity was. As we wrote the instructions, we obtained client input by testing these apps and instructions with clients at the nursing home.

| | Sensory Level Abilities | Exploratory Level Abilities | Planned Level Abilities |
|---|---|---|---|
| **Persona of client** | Client may be easily distracted or demonstrate poor attention span, requiring plenty of guidance during activity. | Client may have moderate attention span and can be encouraged to participate more actively. | Client may have only mild impairments, may express preferences, and require only light guidance in order to sustain activity. |
| **Client Attention Span** | Write activities that do not require linking of steps from one action to the next. | Write activities that support client to follow 1-2 step instructions. | Write activities that support client to follow 2-3 step instructions or make own choices. |
| **Client Problem Solving** | Write activities that have no requirement for choice-making or problem-solving. | Write activities that have no requirement for problem-solving but prompts for client's choice. | Write activities that offer some problem-solving tasks and encourage clients to make choices. |
| **Gameplay Objective of App** | Choose apps with little gameplay objective – purely for sounds or visual appeal. | Choose apps with game objective or scoring system present. | Choose apps with objective or scoring system present. |
| ***Example App*** | *Fireworks Arcade* | *Polly Bubble Tea Maker* | *Polly Bubble Tea Maker* |
| ***Example App-based Instruction*** | *Use 'Start Show' option. Talk about fireworks, celebrations, and childhood memories.* | *Let the resident try to follow each instruction. When needed, help to read the instructions or point out the correct place to tap. Encourage and praise each step.* | *Let the resident lead. Only if needed, Help to read the instructions only if needed. Encourage resident to complete the task on their own.* |

**Table 1 Method of Developing Activities for the Activity Kit. Each activity is made up of an app and instructions for facilitation of engagement. The top section describes the type of apps to pick, and how to write facilitation instructions for a client's particular ability level. The bottom section provides examples. Note that the same app with different instructions can be used for different ability levels (e.g., *Polly Bubble Tea Maker* is used for both the *Exploratory* and *Planned* ability levels).**

Apps were removed from the shortlist if clients found them too difficult despite the task breakdown, or if they were found to have practical problems such as not functioning on the target device, needing a consistent Wi-Fi signal, or having too many disruptive advertisements. For the final list of 19 apps, we created and tested 40 activities (apps and their instructions). Our method of creating these activities is presented in Table 1.

**Profile Development**

As mentioned earlier, we needed to present profile information effectively. Our early paper prototype, which contained the information requested by volunteers in our related work, had too much information. During pilot studies with 10 nursing home volunteers, we found that the volunteers retained only 3–4 Profile elements. Based on this feedback, we further reduced the Profile to what is seen on the left of Fig. 1 - client's interest area(s) and ability level, general instructions on the volunteer's conduct when interacting with clients at a particular PAL ability level are condensed to a maximum of four bullet points. The client's perceptual abilities are presented as a glanceable icon set focusing on the most salient characteristics (hearing, sight, speech, and manual dexterity with a tablet). Finally, there are some written notes from the collaborating therapist regarding the client (e.g., *"prompt often"*). In this way, we balanced the information delivered to a non-primary caregiver (volunteer) with the ability of the caregiver to process and use the information.

**Formative Testing**

Since the Activity Kit as a whole was developed with one collaborating occupational therapist, we decided to validate it with an unrelated group of experts to give feedback on the Kit. We asked three community care therapists to give feedback on the Activity Kit (n=3, all female, age

mean=29.3, total years in dementia care=15). Overall the therapists concurred that the Kit would be useful for their work, the activity associated with each app was easy to understand. They provided some specific suggestions such as shortening some instructions further and adding instructions to ensure that the tablet volume is turned up sufficiently high. These suggestions have been incorporated in the kit.

We also pilot tested the Activity Guide. Our early prototypes contained 3 suggested activities from the Activity Kit, presented in order of execution. Participants in the pilot tests felt constrained by the too-strict activity prescription. We concluded that extreme specificity worked against the purpose of the Activity Guide, which was to enable volunteers to be proficient in interacting with the client. Subsequently, we limited the plan to the first two activities, but for the remaining activity slot, we encouraged the volunteer to actively choose from a suggested list of up to three activities. By permitting leeway, we wanted to encourage the volunteer to take a pro-active role in the engagement facilitation process.

At the end of the development process, we had a glanceable client Profile that helped to quickly introduce salient information on a client to a volunteer. The Activity Kit contained 19 apps and 40 instruction sets, of which 10 were for Sensory Activities, 18 for Exploratory Activities, and 12 for Planned Activities (Fig. 1). Therapists could use the client ability level and interest area to locate appropriate activities in the Activity Kit in order to generate customized Activity Guides. Activity Guides consisted of 1–2 known successful activities as the initial activity (Booster), followed by a second related activity (Related). Finally, there would be a few alternative activities (Suggested). With the content of VITA iterated to a reasonable point of

| | Control Condition | VITA Condition | Therapist Condition |
|---|---|---|---|
| **Client Profile** | Yes | Yes | Yes |
| **Activity Kit Apps** | Yes | Yes | Yes |
| **Activity Kit Instructions** | No | Yes | No |
| **Activity Guide** | No | Yes | No |

**Table 2 Evaluation Conditions**

development, we turned to a summative evaluation to confirm the usefulness of VITA.

## EVALUATION

We conducted a study to investigate how VITA compares against the current practice of tablet-based engagement activities (Control Condition) and with the best-case scenario, a one-on-one, therapist-delivered tablet-based engagement activity (Therapist Condition).

## Participants

### Client Participants

We recruited client participants from our partner nursing home. The inclusion criterion was a documented diagnosis of dementia. The exclusion criteria were: the client had an accompanying diagnosis of bipolar disorder or schizophrenia, had no dexterity or movement in either hand, could not be seated in a chair/wheelchair, had a MMSE (Mini Mental State Exam) score of 23 or above, or was younger than 60 years of age.

Fourteen potential participants were identified. Three of the potential study participants' next-of-kin could not be reached for consent. One client refused to participate in the activity, and another was unwell. Replacements were purposively sampled in order to have clients for each ability level represented in the study. This resulted in 9 clients for our study (male n=5; age $M$=84.3, $SD$=8.6; MMSE $M$=13.4, $SD$=6.4). Ethnic representation of the participants included 6 Chinese, 1 Indian, and 2 clients of Eurasian origin. There were 3 participants at each ability level.

The home's occupational therapist profiled these participants to determine their PAL ability level, interests, and perceptual abilities with regard to tablets (visual, auditory, speech, and manual dexterity). These elements became the contents of the client's Profile. The time between Profile creation and the completion of evaluation was less than three weeks.

### Volunteer Participants

Volunteer participants were students recruited from three tertiary institutions who were already visiting the home for service learning projects. Participants were compensated for their travel costs with a grocery voucher.

In all, 18 volunteer participants were recruited (male n=9; $M$=21.1, $SD$=4.2). Participants completed a pre-session questionnaire for control information on any prior experience with dementia, and languages spoken for matching with the clients. None of the volunteer
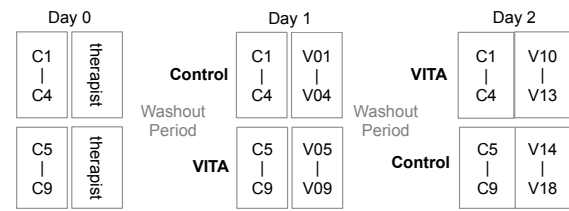


**Figure 2 Study Design Showing Counterbalancing Order for Control and Test with Clients (C) and Volunteers (V)**

participants reported any dementia-care training or having lived with older adults with dementia.

## Apparatus

Our application launcher was loaded onto 4 Samsung Tab Pro 10.1 Tablets, running Android v. 4.4.2. For recording video, we used 4 Sony HDR-XR550E cameras with shotgun microphones attached to increase sound quality.

## Method

### Study Design

Our study involved 2 factors: Content delivery method and client's ability level. Content delivery method had three levels Control, VITA and Therapist. The client's ability level had three levels (Sensory, Exploratory, and Planned). Content for each condition is listed in Table 2. The Control condition mimics current practice where volunteers are given apps selected by care staff with general instructions. In the VITA condition, volunteers have the additional access to the facilitated instruction supplied by the Activity Kit. In the Therapist condition, a Therapist facilitates engagement as an expert, using just the Activity Kit apps.

Our study comprised of two sets of participants: clients and volunteers. To avoid potential interference between the test conditions, it would have been preferable to use a between-subject design for the delivery method factor for both types of participants.

However, due to the difficulties we had recruiting suitable clients, we were only able to conduct between-subjects testing for volunteers. Thus, the volunteers were randomly assigned to Control or Test, but met the same clients for all experimental conditions (within-subject for the clients).

The study design is detailed in Fig. 2. While involving the same clients in multiple test conditions may risk learning effects, in practice, the risk is largely reduced for these clients due to memory impairments [5]. To further reduce any risk, we applied a washout period of 6 days between conditions. At the same time, within-subjects testing for clients is particularly useful, as it helps to account for variance introduced by each client's unique set of abilities. Such study designs are not uncommon, especially for studies with caregiving dyads [e.g. 26].

All testing took place in the morning between 9 am and 11 am when the clients are the most alert. Volunteer participants were given 15 minutes to familiarize

themselves with the Profile, Activity Guide and the pre-loaded apps on the tablet.

**Testing Setup**



**Figure 2 Testing Setup**

Subsequently, they were briefly introduced to the client in the testing room and were asked to offer the activities "based on the Profile and Guide", for up to 30 minutes. If the client indicated that they wanted to stop, they could do so. A video camera was set up for a medium, frontal view of the volunteer and the client (Fig. 3).

**Measures**

*Client Engagement Measure*

Since clients cannot self-report on their level of engagement, we selected a behavioral observational scale as the measuring instrument. Cohen-Mansfield's Observational Measure of Engagement (OME) was created specifically to measure engagement behavior. The OME is a validated method for measuring engagement and has been widely used at nursing homes [8]. For full psychometric properties of the OME, see [6].

In the OME, a trained observer uses a scored checklist to determine client *attitude* and *attention* during engagement. The method converts the observed behaviors into a numerical score between 2 to 34. A maximum score would require the client to be very attentive, to the point of being proactive, and maintain a very positive attitude, laughing and interacting continuously. On the other hand, the theoretical minimum would require a completely inattentive client who was disruptive or distracted most of the time, with a highly negative attitude.

To ensure objective scoring, two research assistants were trained on a 15-minute sample video of clients interacting with tablets. Discussion of the OME coding followed, as feedback for their coding choices. After training, they coded the client-volunteer interaction videos independently. Cohen's κ showed high agreement between the two coder's observations (0.82, p<0.01). Since the value was consistent with previously reported OME values [7], the scores were averaged to arrive at the final client engagement scores.

*Volunteers' Measure*

We constructed a post-session 14-item questionnaire to measure the following responses: usability of the system (6 items), usefulness of the client Profile (2 items) and activity guide (2 items), satisfaction with the apps used (2 items), and the amount of information presented (2 items). Items

were graded on a 5-point Likert scale, which resulted in a score of 10 for each segment.

**RESULTS**

**Client Engagement**

Since the delivery method was a within-subject factor for clients, but client ability level was a between-subject factor, we conducted a two-way mixed ANOVA to compare the effect of the three delivery methods and three client ability levels on engagement scores. However, since the sample size was relatively small and the data was non-parametric, we used Aligned Rank Transform (ART) [38] as the statistical test. Fig. 4 (left) presents the engagement scores by clients' ability level and delivery method.

We found a significant main effect on the delivery method ($F_{2,12}$=8.00, *p*=.006). Pairwise t-Tests with Tukey corrections showed that the engagement measure score of both the VITA (*M*=25.7) and Therapist (*M*=26.1) delivery methods are significantly better than that of Control method (*M*=21.8) (all *p* < .05). No significant difference was found between the engagement measure of VITA (*M*=25.7) and Therapist (*M*=26.1) delivery methods (*p*=.99).
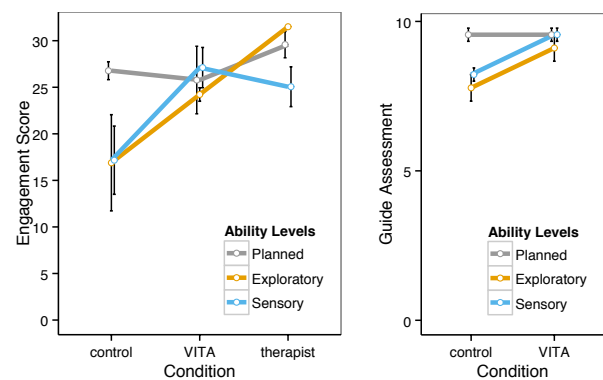


**Figure 4 Clients' Average OME Score (standard error) (left) and Volunteer Guide Assessment by Delivery Method and Clients' Ability level (right)**

These results have two implications. Firstly, volunteers in the VITA condition had a significantly higher client engagement score than in the Control condition, with an average increase of 18%. Cohen's effect size for client engagement (0.838) suggests a high practical difference between control and VITA delivery methods. Secondly, with the use of the Activity Guide, volunteers could achieve levels of client engagement comparable to an expert's.

**Volunteers' Assessment of the Activity Guide**

Unlike the previous analysis, the delivery method for volunteers is a between-subject factor with only two levels. Therefore, using ART again, we carried out a two-way ANOVA to compare the effect of the delivery methods and client ability level on the volunteers' assessment of the Activity Guide. In Fig.4 (right) the chart shows the volunteers' assessment of the Activity Guide component of VITA across delivery methods and client levels.

We found a significant main effect on delivery method ($F_{1,6}$=12.56, *p*=.01), indicating that overall, volunteers perceived VITA to be useful. However, there was also a significant main effect on ability level ($F_{2,6}$=5.69, *p*=.04), and a marginal significance on the interaction term ($F_{2,6}$=3.71, *p*=.09). A visual examination of the interaction plot Fig. 4 (right) suggests it was the Planned Level data that was the source of the interaction effect. When we removed the data from Planned Level clients, and ran the ANOVA again, there was only a significant effect of the condition ($F_{1,4}$ =19.3, *p*=.01), and no main effect from the Ability Level ($F_{1,4}$=1.6, *p*=.27).

These findings suggest that volunteers interacting with Planned Level residents had a different perception of the utility of VITA, as compared to those with Sensory and Exploratory residents. In other words, the results suggest that volunteers interacting with clients at the lower levels of ability (Sensory and Exploratory) perceived the Activity Guide to be more useful, even though the actual difference in Resident outcomes was not large.

As might be expected, there were no other significant differences among volunteers' ratings of the Profile content (*M*= 8.56, *SD*=1.46), quality of apps used (*M*= 8.22, *SD*=1.35), amount of information (*M*= 8.22, *SD*=1.26), and system usability (*M*= 23.50, *SD*=3.01).

### Qualitative Findings

To explain the findings, we examined the videos of volunteers' usage of the Activity Guide provided in VITA and report also their post-session verbal feedback. In the Control condition videos, we observed volunteers having to spend more time experimenting and briefly testing some apps before finding an appropriate app for the client. In contrast, volunteers in the VITA condition appeared more confident of their choices and spent more of their time explaining the content of the applications and consequently engaging the client. Post-session interviews with volunteers shed light on this observation. Volunteer P8 (VITA condition) said this of the system: *"Easier way to get to know elderly because of Profile. (The) recommendations were great, and guide was very good. (The) information was adequate, nothing else was needed"*.

Volunteers also appeared more confident in leading the client. This might have been the result of having the activity 'booster' which improved the likelihood that the client would be interested. One of the reported benefits of using the Activity Guide was to help to specify the choices of engagement activities. Volunteer P1 (VITA condition) said that the customized instructions helped her to "...*select only what was important for the apps. Otherwise there were too many and I didn't know what he wants."* The list of activities also acted as a backup plan. When encountering disinterest in the 'booster' activity, Volunteer P11 (VITA condition) related her coping experience: *"Some apps were not appropriate. Even though I started with Float Free, the*

*resident got bored, so (I) try (sic) other things... Water Colors was better."*

In contrast Volunteer P3 (Control condition) said: *"Enough info – yes, it's mainly information for starting to know about elderly. More information would be nice if...if elderly have used system before, show information about their preference and interest! You should recommend apps for each one."*

Finally, the videos show that volunteers in the VITA condition gave instructions more slowly, in a step-wise manner. This was in accordance with the instructions to offer single step guidance to the more severely impaired clients. The effectiveness of this behavior aligns with Jost et. al. [20]'s finding which suggested training dementia care volunteers to 'match pace' with the client. On the whole, the Activity Guide was functioning as intended in supplying appropriate content and instructions.

However, the volunteers who were paired with Planned Level clients expressed a conflicting wish. When shown both Guides, Volunteer P7 (VITA condition) preferred having fewer instructions: *"Variety was good to have. (The) Profile helps to start communicating, but Guide B is more preferred, even though Guide A (VITA) had more detail."* She felt it gave her more flexibility to respond to the client.

Another volunteer in the Control condition, P9, preferred the Guide version she was given, and reported thinking that she should *"hold back more during the session, to let the client direct it."* It seemed that less specificity was preferred when interacting with Planned Level clients.

## DISCUSSION

Overall, both qualitative and quantitative findings lead us to conclude that VITA, composed of recommended apps and ability-customized facilitation instructions, can be used by volunteers to improve efficacy in engaging residents with dementia, with possibly a stronger perceived value among volunteers engaging clients with lower abilities. In addition to the main findings, we also have a few learning points, which we elaborate below.

### Differential Results by Dementia Severity

A handful of previous work on engagement stimuli studies [9, 10] showed that higher functioning clients may have differing responses when compared to lower functioning clients, but little explanation was offered beyond having a longer attention span. In the case of this study, our Planned Level clients appeared to retain the ability to express preferences and maintain conversation with the facilitating partner. Since volunteers could get direct and immediate feedback from the clients, the verbal exchange was likely the most effective form of communication. This reduced the value of additional instruction, as indicated by the feedback from volunteers who used Activity Guides for Planned Level clients.

However, for clients who had lower abilities, just providing the pre-selected apps and Profile information to volunteers was not enough. It may be that this segment of the client population has more impaired communication, and inexperienced volunteers lack the ability to compensate for this loss. In this case, simple trial and error with the client did not work well, as it is difficult for the volunteers to get the needed feedback so that s/he can adapt his/her behavior to the situation. More specific guidance seemed to be appreciated by the volunteers.

These differential results may have implications for other dementia engagement researchers, as it raises the importance of analyzing intervention outcomes by client impairment severity, which is not often done. Such analyses will enable a better understanding of how interventions may be targeted. Considering that dementia is a progressive disease, understanding the effect of interventions over different stages of the disease will help the design of systems that should adapt to changes in the target user over time.

### Improving Information for Volunteers

In our design, we took pains to iteratively and consultatively develop the Profile. We attempted presenting more types of background information (e.g. family history), but volunteers still appeared unable to process the information toward improving their interactions with people with dementia. Consequently, the design of the resulting Profile preferred glance-ability and ease of understanding over depth of information.

The process of Profile development uncovered a discrepancy between what volunteers have previously expressed an interest in and what volunteers can actually utilize. This is an important learning point for future work in client information systems for volunteers: even when volunteers express a specific need for information, the delivery of such information needs to be carefully balanced with how it can be digested and applied.

This did not mean that Profile content was of no use in the process of improving volunteer efficacy. Profiling for interest and ability levels formed the basis by which the Activity Guide, which *was* effective, was created. Thus, while our findings affirm related work on the importance of profiling, this study additionally suggests that inexpert caregivers should be helped in closing the knowledge-behavior gap by efficiently *translating and presenting* such information as appropriate instructions for interacting with each individual with dementia.

### Reducing effort to maintain volunteer programs

VITA has the potential to reduce the amount of work needed to maintain an engagement activity program. Together, the profiling (up to 30 minutes), activity selection and guide generation (up to 20 minutes) result in a total customization time of less than an hour. Similar physical activity customization programs require about 8 hours of therapist time to customize activities for each client and train each caregiver [16]. According to the home's

therapist, each Profile can be valid for about 6 months. Training time for volunteers was set at 15 minutes in this assessment, which is far less than the previously mentioned studies that place volunteer training at a minimum of 5 hours. Therefore, despite the initial time investment to curate an Activity Kit (which is highly re-useable), VITA can result in significant time savings.

### Summary of VITA development

As mentioned in the development section of this paper, localized, culture- and cohort-specific content is an important element of engagement among clients. Thus, we present here the process of creating the VITA (Fig.5) for other care centers wishing to implement a tablet-based engagement activity program that utilizes the services of non-expert facilitators.
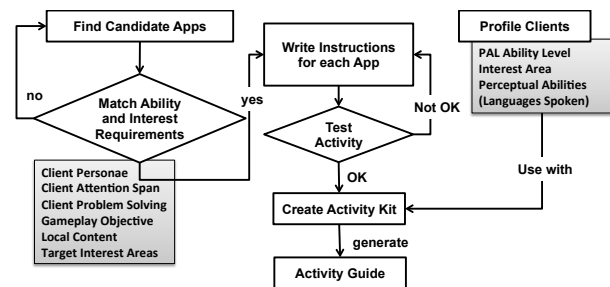


**Fig. 5 VITA Creation Workflow**

### Limitations and Future Work

Although the result of our study is promising, a longer-term evaluation is needed to examine other related outcomes such as a reduction in negative psychosocial behaviors and impacts on the nursing home's management of volunteers. A longer-term study would enable increased understanding of sustainability and viability of VITA in the community, while unpacking further how to meet the different needs of clients with milder impairments.

### CONCLUSION

The goal of our work was to meet an observed need for systems to support volunteer interactions when facilitating engagement activities to clients. In our evaluation, we found that VITA, the artifact resulting from our iterative design process could improve engagement outcomes for clients, by translating biographical information into actionable activities for untrained volunteers. In so doing, the system benefits nursing homes via the creation of a potentially stable resource for engagement activities out of a non-expert, transient volunteer population, and by saving time in deploying a volunteer expertise improvement program. In enabling more effective caregiving by volunteers, VITA represents advancement toward improving the quality of life for nursing home residents living with dementia.

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