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A Person Living With Dementia Learning to Navigate an iPad: A Case Study

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Abstract

Purpose: This study challenges the notion that people living with dementia are unable to achieve novel learning without focused intervention techniques. The purpose of this study is to explore how a woman living with dementia (Alzheimer's disease) learns to use a tablet computer with support from communicative partners.

Method: The study is based on video recordings and the theoretical framework of learning as changing participation in joint activities. Quantitative and qualitative focus is on changes in the interactional organization over the course of six weeks in the activity of using an augmentative and alternative communication application.

Results: Over time, the participant living with dementia, relies less on the expertise and explicit instructions of her communicative partners when navigating the application, and more on the immediate feedback provided by the tablet computer.

Conclusions: The findings suggest that novel learning still is possible for people living with dementia, even without the implementation of focused interventions. This study further emphasizes the procedural nature of learning for people living with dementia as the woman's embodied actions were carried out in an increasingly more direct fashion.

Keywords

Collaborative learning, Gerontechnology, Communicative projects, Interaction analysis, Directives

Introduction

People living with dementia are often faced with unquestioned assumptions about their cognitive and social capabilities, or rather lack thereof, as a result of the diagnostic label and
its clinical connotations [1]. Cognitive and social capacities that are commonly perceived as being insufficient in people living with dementia are, among many, their capability to cooperate in interaction [2], sustain attention and engagement in activities [3], take communicative initiatives [4] and learn or re-learn information and skills [5,6].

With evidence of clear decline in memory functions being one of the diagnostic criteria for mild or major neurocognitive disorder due to Alzheimer's disease [7], there is a vast body of experimental research on how dementia, especially Alzheimer's disease, affects learning (e.g., [8-10]). In the early stages of Alzheimer's disease, the memory impairments mainly affect declarative memory functions, whereas procedural memory functions usually remain preserved [11]. The primary focus of studies regarding learning and dementia has been on teaching the person with dementia through implementing specific, or combined, intervention techniques intended to facilitate learning. Some reoccurring interventions include errorless learning (e.g. [12,13]), spaced retrieval (e.g. [14,15]), and vanishing cues (e.g. [16,17]). Errorless learning aims at preventing the person living with dementia from making any errors in performing the task at hand. It is argued that avoiding errors in the learning process, through means such as immediate correction in the light of a possible error, will minimize the risk of incorrect learning [12]. Spaced retrieval is a technique where the person living with dementia is asked to recall targeted information, such as object naming, with gradually expanded intervals. If the desired information is not recalled the correct answer is provided and the interval is reduced until the learner manages to recall the information [18]. The vanishing cues technique has mainly been used in studies focusing on face-name associations. In these studies pictures of faces with a corresponding name are presented, and the person with dementia is asked to recall the name. Initially the names are completely spelled out, and over subsequent presentations the letters are removed one at a time from right to left until the person is able to recall the name with minimal cues [19].
While these studies unanimously report that learning still is possible for people living with dementia given focused and structured interventions, few studies address novel learning in everyday life of people with dementia. By studying learning in everyday life, one circumvents the experimental context that is usually applied and attains access to learning trajectories of high ecological relevance [20]. Moreover, in most experimental studies, the organization of the learning process in terms of the interaction between the learner and the "expert" has not been studied. A focus on the organization of the learning process could help us to understand how people living with dementia for instance take over some of the actions proposed by the "expert" and execute these by themselves.

**Learning and participation**

Theories of learning in everyday life regard learning not as something restricted to situations of structured teaching or something explicitly located in the mind of the individual learner. Instead learning is considered a process intrinsic to all activities of everyday life and distributed amongst individuals acting in concert with each other and any artefacts in the environment [21,22]. As such, learning is closely tied to collaboration and interaction. Learning could further be considered to be a process that unfolds over time, a process that can be conceptualized as a change in the participation in situated joint activities [23-25].

With the centrality that interaction has for learning, Wagner, Pekarek Doehler and González-Martinez [26] argue that a systematic analysis of change in interactional patterns is crucial in order to understand changing participation in activities of everyday life. To take part in activities with others is to engage in what Clark [27] calls joint activities. Joint activities, in turn, usually comprise several smaller joint projects [28]. The joint activities consist of embedded joint projects, and progress incrementally through new contributions made by each individual participant engaged in the activity. The contributions are produced in relation to the
ongoing joint project, that is the participants collaborate and coordinate their contributions to achieve a mutual understanding sufficient enough for current practical purposes [29,30].

Each contribution builds on, and adds to, the participants' common ground, that is their shared interactional history [20]. When a contribution signals uncertainty, indicating insufficient understanding, the participants jointly engage in a problem-solving process or repair work to reach a mutual understanding sufficient enough for the activity to proceed [31,32]. In this fashion, conduct is treated as unproblematic when contributions provide no need for repair work [26,27].

Much of the contemporary theories on learning as changing participation draw influence from the sociocultural perspective originally proposed by Vygotsky [33]. According to Vygotsky's [33] idea of the zone of proximal development, learning is seen as dependent on participation involving more experienced members of a community. In interaction more experienced individuals, the "experts", are capable of structuring activities in ways that enable less experienced individuals, the novices, to participate (also see [24]).

While most joint activities build on some type of asymmetrical relationship between the participants in regard to either knowledge or communicative labor [34], this asymmetry might be especially prominent in interactions involving cognitively healthy people and people living with dementia [4]. Hydén [35] argues that cognitively healthy interlocutors can compensate for the progressive cognitive and communicative challenges associated with dementia by contributing more in joint activities. This can be done by taking more responsibility in planning activities, engaging in advanced repair work and keeping track of already accomplished projects embedded in the activity. Further, to compensate for a potentially diminished attention span the use, and placement, of relevant artifacts in the environment can aid sustained interaction [35,36]. By providing appropriate support the joint activity is scaffolded, enabling the person living with dementia to participate in ways he/she could not do otherwise [2].
Thus, in order to study learning in everyday life it is necessary to capture changes in participation in joint activities, something that can be done by scrutinizing similar sequences occurring over a stretched period of time \[30,37\]. Clark and colleagues (e.g. \[28,38,39\]) as well as Knutsen et al. \[32\] have shown how cognitively healthy people participating in repeated trials of matching tasks gradually need less time, use fewer turns, and also less words to complete joint projects. While these studies are all experimental they show how common ground, over time, accumulates making extended negotiations less necessary. Put differently, the distance between the "expert" and the "novice" has diminished with the novice's gradual growth of involvement in the activity \[21,36\]. To our knowledge there are no studies to date exploring novel learning and interaction in everyday life as changing participation in joint activities for people living with dementia.

Building on this line of argument, the aim of this article is to explore learning as an everyday activity detached from formal interventions in experimental settings through focusing on the case of learning to handle a tablet computer (henceforth referred to as iPad). Specific interest is on the interactional organization of the learning process.

**Materials and methods**

In order to explore the possibilities of this theoretical framework a case study design has been used. The study is based on video data recorded in the home environment of a woman (Ida), 52 years old, diagnosed with Alzheimer's disease roughly one year before data collection started, and her cognitively healthy husband (Max). The data was collected as part of a project aiming to evaluate the use of a personalized communication application for an iPad (see \[40\]). The original study had no focus on learning and the only instructions given to Ida and Max was to record themselves using the application. No formal testing was carried out to assess Ida's level of cognition, speech or language prior to her participation in the study. Though the couple
reported that they experienced great communicative difficulties relating to Ida's expressive and receptive language abilities. Further, Ida showed clear difficulties with episodic memory.

The data used in this study comprises five recordings collected over the course of six weeks. The first four recordings are of Ida and Max whilst the last recording is of Ida and Unni, a researcher who participated in the original study. Each recording is of the participants interaction using an iPad and the application GoTalk NOW. GoTalk NOW is a customizable application developed to function as an augmentative and alternative communication device. The application is designed to work like a communication book and can be suited to the individual user with personal pictures or video clips, and a possibility for written information complimenting each item. GoTalk Now is "layered" in the sense that there is a home screen with 1-25 items or categories and after selecting a category the application proceeds to a new screen with a similar structure but containing items adherent to the specific category. Apart from navigating to subordinate screens, by tapping on a specific category, one can navigate to a preceding screen by tapping a backwards arrow at the bottom left hand corner of the application or go directly to the home screen by tapping on a symbol of a house which is located next to the backwards arrow.

The methodological point of departure is informed by practices of conversation analysis and interactional analysis based on detailed transcriptions of the couple's verbal and non-verbal contributions to the unfolding activities. In accordance with the studies by Linell as well as Clark and colleagues (e.g. [28,30,34,38]) presented earlier, the participants' number of turns, words and time used in completing joint projects were quantitatively measured. In the analysis, a joint project was considered to start with an initiative by one of the participants, and considered completed when the proposal of a new project takes place [27]. A turn was defined as a speaker's continuous verbal or embodied contribution to the ongoing discourse [34,41]. When quantifying, the definition of a word was based on spoken language where contractions
such as "wanna" (want to) counted as one word, as did backchannel responses such as "uh". All excerpts presented in this study are translated from Swedish to English.

Following the methodological requirements when studying learning posed by Koschmann [37] and Linell [30,42], sequences of reoccurring joint projects within and across the different recordings were chosen for further analysis. More specifically, instances of (i) unlocking the iPad (n=4), (ii) navigating to the home screen (n=6), (iii) navigating to the preceding screen (n=20) and (iv) closing the application (n=3) were selected. As a whole, the data inevitably comprises more joint projects than those selected for further analysis. The selection was limited to local projects where novel learning could occur. Apart from receiving a short introduction on how the iPad and application worked prior to their participation, neither Ida nor Max had any previous experience of using tablet computers. As such any development in managing the iPad and navigating through various screens of the application would indicate novel learning, whereas selecting and discussing familiar photographs would not.

All participants in this study are anonymized, ethical approval was obtained from the Regional Board for Ethical Vetting at Linköping University (2017/469-31) and the data collection was permitted by the participants through written informed consents.

Results

In the following, results from each of the reoccurring four local projects are presented. The quantitative results are reinforced with transcribed excerpts highlighting the qualitative findings around the organization of the interaction. In order to accentuate the interactional changes seen over time, we have primarily included excerpts of the first and last occurrence of a local project.

Unlocking the iPad

The iPad unlocks through a feature called "Slide to unlock". This means that prior to starting the application the participants have to press the physical home button located in the frame of
the iPad and then drag a slider that appears onscreen to the side. When the fifth recording started, the iPad was already unlocked, hence the results reported below are from the first four recordings.

Table 1. Quantitative measures – unlocking the iPad.

<table>
<thead>
<tr>
<th></th>
<th>Number of turns (M/I)</th>
<th>Max, Words (%)</th>
<th>Ida, Words (%)</th>
<th>Max, Words/turn</th>
<th>Ida, Words/turn</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>First week</td>
<td>29 (15/14)</td>
<td>103 (74.1)</td>
<td>36 (25.9)</td>
<td>6.87</td>
<td>2.57</td>
<td>73s</td>
</tr>
<tr>
<td>Second week</td>
<td>34 (17/17)</td>
<td>81 (57.9)</td>
<td>59 (42.1)</td>
<td>4.76</td>
<td>3.47</td>
<td>43s</td>
</tr>
<tr>
<td>Third week</td>
<td>8 (4/4)</td>
<td>20 (58.8)</td>
<td>14 (41.2)</td>
<td>5</td>
<td>3.5</td>
<td>11s</td>
</tr>
<tr>
<td>Fourth week</td>
<td>26 (13/13)</td>
<td>69 (60.5)</td>
<td>45 (39.5)</td>
<td>5.31</td>
<td>3.46</td>
<td>82s</td>
</tr>
</tbody>
</table>

Table 1 presents an overview of the quantitative measures depicting Ida's and Max's interaction when completing the local project of unlocking the iPad. Notably, in the first three recordings of our data there is a clear decrease in the time needed to unlock the iPad. Similarly, the number of turns required to complete the project is considerably fewer in the third recording. In the fourth recording, there is a steep increase in both time and turns needed. However, as is discussed later, there is a noticeable change in the participants' interactional organization also in this final instance. That Ida, over time, relies less on the expertise of Max is clearly seen in the following two excerpts.
During the first week, neither Ida nor Max show any clear signs of expertise in how to unlock the iPad. As excerpt 1 shows, the local project is initiated by Max producing the recognition check (lines 1 & 3) "do you remember how to start this gizmo now again". Ida responds to this by stating that she does not know how to start the device (line 4-7). Nevertheless, Ida simultaneously responds by pressing on the physical camera (line 6). Here, Max does not pursue
the project through subsequent instructions, as is the case in future instances, but instead attempts to unlock the iPad himself (line 10-16). Max first repeats what Ida already tried, that is pressing on the camera lens (line 12), and then after picking up the iPad and scrutinizing it suggests that it might be dead (line 15). After pressing the physical home button (line 16), Max explains how one should do this (line 17), to which Ida responds with a request for clarification "what did you say" (line 18). Max then repeats his explanation with an adherent pointing gesture (line 19). Following an additional request for clarification from Ida (line 20-21), during which the screen goes black, Max affirms Ida's request with a "yes but" construction and thus refrains Ida from further action. Upon this, the project gets interrupted and continues in line 27 with Max producing the imperative "then we drag it to the side" with an accompanying iconic swipe gesture. With no response from Ida, Max reframes his directive with additional information "you just drag on the glass in one direction" (line 28) to which Ida complies. During the following 8 seconds (line 30-35), two similar sequences occur after which Max himself swipes his finger across the screen and realizes that the screen is not active (line 36). Max subsequently points to the physical home button and tells Ida to start the device again to which Ida responds with a request for clarification and does not press the button until after Max reassures her (line 37-40). The project is ultimately completed with Max unlocking the iPad (line 45-46).

During the second week, the project unfolds in a similar fashion with Max pursuing the completion of the project through verbal and embodied directives towards Ida who often responds with requests for clarification. However, unlike the first recording the project is ultimately completed by Ida.
Excerpt 2, Unlocking the iPad, Third week

01 M: should we start to view this thing now,
02 I: [yea: "right"] ((presses the
03 physical home button and the screen lights up)) it was that one
04 right?
05 M: m and then ((does a swipe motion in front of himself))
06 I: one should go back !right? ((swipes back and forth above the
07 screen))
08 M: you drag it in >"that direction"< ((swipes in front of himself))
09 I: ((swipes across the screen and the tablet unlocks)) there=
10 M: =there we go.=
11 I: =yea

In the third recording (see excerpt 2) the project is again initiated by Max (line 1). Ida responds to Max's initiative by pressing on the physical home button (line 2) without any preceding explicit verbal or deictic clue from Max. While Ida does produce a request for clarification with "it was that one right" (line 3-4), she executes the action before Max confirms her question. In line 6 Ida again requests confirmation, though simultaneously performs the correct gesture albeit above the screen. Following Max's response (line 8), Ida unlocks the iPad and thus completes the project.

In the fourth recording, Ida is seen pressing the physical camera lens three times before shifting her gaze to the opposite side of the iPad and requesting clarification on whether or not she should press there. Upon Max’s confirmation, Ida presses the physical home button and the screen lights up. However, all text on the display is upside down whereby Max rotates the device 180 degrees and the joint project starts anew. Following this, there are two sequences unfolding in a similar way; after pressing the physical home button, Ida does not manage to drag the slider across the screen in time and thus the screen goes black. Ida finally completes the joint project without any preceding clues from Max.

Navigating to the home screen

In our data there are six instances, in three separate recordings, of the participants engaging the local project of navigating to the home screen. The first two recordings are of Max and Ida, and the fifth recording is of Ida and Unni.
Table 2. Quantitative measures – navigating to the home screen.

<table>
<thead>
<tr>
<th>Instance</th>
<th>Number of turns (M/I)</th>
<th>Max, Words (%)</th>
<th>Ida, Words (%)</th>
<th>Max, Words/turn</th>
<th>Ida, Words/turn</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>First week</td>
<td>#1</td>
<td>19 (9/10)</td>
<td>49 (80.3)</td>
<td>12 (19.7)</td>
<td>5.44</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>#2</td>
<td>4 (2/2)</td>
<td>16 (88.9)</td>
<td>2 (11.1)</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>#3</td>
<td>4 (2/2)</td>
<td>13 (86.7)</td>
<td>2 (13.3)</td>
<td>6.5</td>
<td>1</td>
</tr>
<tr>
<td>Second week</td>
<td>#1</td>
<td>14 (7/7)</td>
<td>34 (75.6)</td>
<td>11 (24.4)</td>
<td>4.86</td>
<td>1.57</td>
</tr>
<tr>
<td></td>
<td>#2</td>
<td>7 (3/4)</td>
<td>22 (84.6)</td>
<td>4 (15.4)</td>
<td>7.33</td>
<td>1</td>
</tr>
<tr>
<td>Sixth week*</td>
<td></td>
<td>6 (3/3)</td>
<td>22 (81.5)</td>
<td>6 (18.5)</td>
<td>7.33</td>
<td>2</td>
</tr>
</tbody>
</table>

As seen in table 2, the time needed to complete the project progressively decreases both within and between the different recordings. The same pattern is seen regarding the number of turns needed in completing the project, with fewer turns both within and across the recordings. In the excerpts bellow, which are five weeks apart, it is clear that Ida has learned how to complete the local project without first receiving additional verbal or gestural promptings.

Excerpt 3, Navigating to the home screen, First week, Instance 1

01 M: {{points to the bottom of the screen}} then you see that there is a
02 (1.0) a house there {{points to the bottom of the screen}}
03 I: yea
04 M: if you press on it?
05 I: {{points out to the room}} that one?
06 (0.7)
07 M: {{looks in the direction of Ida's pointing}} (0.6) no {{points
to the bottom of the screen}}
09 I: [no
10 M: [on the house that's there (0.5) do you see the house there
11 I: {{leans forward and points to the screen}}
12 M: don't you have any glasses you don't [see anything
13 I: [yea {{grabs glasses}}
14 I: I have them [here {{puts on her glasses}}]
15 M: [put them on {{points to the bottom of the screen}}
16 M: do you see the symbol there [with a house
17 I: [yea
18 I: [yea:
19 M: [pre- press on it
20 I: yea {{presses the symbol and the home screen appears}}
21 M: there
22 (0.7)
23 I: m

The two first recordings of the participants navigating to the home screen unfold in a similar fashion to the project of unlocking the iPad. That is the projects are initiated by Max who
provides step-by-step directives for Ida to follow. Max’s directives are continuously accompanied by either verbal prompts such as “press” and “house” or deictic gestures, often in combination. In the first instance of the first recording (see excerpt 3) Ida does not appear to grasp that the home symbol is not a representation of their house and thus points outwards into the room (line 5). This misperception is not seen in the second recording.

Excerpt 4, Navigating to the home screen, Sixth week

01 U: how do one get to the first page [I-
02 I: [the first page? .hh (moves
03 her hand towards the bottom of the screen))
04 U: I have almost forgotten what I [did myself
05 I: ((presses the home symbol))
06 [I only took a chance now
07 U: [like that yes no but you're only taking a chance?
08 I: *yea*

In the fifth and final recording, which occurs four weeks after the second recording, Unni is seen initiating the project (excerpt 4, line 1). Unlike Max, Unni initiates the project with an open-ended question rather than an explicit directive. Ida subsequently moves her hand to the correct position and presses the home symbol without any preceding verbal or deictic prompt.

Navigating to a preceding screen

There are twenty instances, across four recordings, where the participants partake in the local joint project of navigating to a preceding screen. The first three recordings are of Max and Ida, and the final recording is of Ida and Unni.
Table 3. Quantitative measures – navigating to a preceding screen.

<table>
<thead>
<tr>
<th>Instance</th>
<th>Number of turns (M/I)</th>
<th>Max, Words (%)</th>
<th>Ida, Words (%)</th>
<th>Max, Words/turn</th>
<th>Ida, Words/turn</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>First week</td>
<td>#1</td>
<td>6 (3/3)</td>
<td>16 (84.2)</td>
<td>3 (15.8)</td>
<td>5.33</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>#2</td>
<td>2 (1/1)</td>
<td>4 (80)</td>
<td>1 (20)</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>#3</td>
<td>6 (3/3)</td>
<td>10 (58.8)</td>
<td>7 (41.2)</td>
<td>3.33</td>
<td>2.33</td>
</tr>
<tr>
<td></td>
<td>#4</td>
<td>3 (2/1)</td>
<td>10 (71.4)</td>
<td>4 (28.6)</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>#5</td>
<td>7 (4/3)</td>
<td>33 (84.6)</td>
<td>6 (15.4)</td>
<td>8.25</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>#6</td>
<td>13 (7/6)</td>
<td>38 (67.9)</td>
<td>18 (32.1)</td>
<td>5.43</td>
<td>3</td>
</tr>
<tr>
<td>Mean value</td>
<td>6.17</td>
<td>18.5</td>
<td>6.5</td>
<td>5.22</td>
<td>2.22</td>
<td>9.67s</td>
</tr>
<tr>
<td>Second week</td>
<td>#1</td>
<td>6 (3/3)</td>
<td>14 (58.3)</td>
<td>10 (41.7)</td>
<td>4.67</td>
<td>3.33</td>
</tr>
<tr>
<td></td>
<td>#2</td>
<td>9 (4/5)</td>
<td>17 (73.9)</td>
<td>6 (26.1)</td>
<td>4.25</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>#3</td>
<td>3 (1/2)</td>
<td>9 (81.8)</td>
<td>2 (18.2)</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>#4</td>
<td>4 (2/2)</td>
<td>7 (77.8)</td>
<td>2 (22.2)</td>
<td>3.5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>#5</td>
<td>3 (2/1)</td>
<td>7 (87.5)</td>
<td>1 (12.5)</td>
<td>3.5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>#6</td>
<td>2 (1/1)</td>
<td>6 (85.7)</td>
<td>1 (14.3)</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Mean value</td>
<td>4.5</td>
<td>6</td>
<td>3.67</td>
<td>5.15</td>
<td>1.42</td>
<td>5.83s</td>
</tr>
<tr>
<td>Third week</td>
<td>#1</td>
<td>5 (3/2)</td>
<td>17 (89.5)</td>
<td>2 (10.5)</td>
<td>5.67</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>#2</td>
<td>8 (4/4)</td>
<td>25 (86.2)</td>
<td>4 (13.8)</td>
<td>6.25</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>#3</td>
<td>3 (2/1)</td>
<td>10 (90.9)</td>
<td>1 (9.1)</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>#4</td>
<td>2 (1/1)</td>
<td>9 (90)</td>
<td>1 (10)</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>#5</td>
<td>3 (2/1)</td>
<td>7 (43.8)</td>
<td>9 (56.2)</td>
<td>3.5</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>#6</td>
<td>3 (2/1)</td>
<td>8 (88.9)</td>
<td>1 (11.1)</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>#7</td>
<td>6 (3/3)</td>
<td>12 (66.7)</td>
<td>6 (33.3)</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Mean value</td>
<td>4.29</td>
<td>12.57</td>
<td>3.42</td>
<td>5.35</td>
<td>2.29</td>
<td>5.43</td>
</tr>
<tr>
<td>Sixth week*</td>
<td>#1</td>
<td>3 (2/1)</td>
<td>18 (62.1)</td>
<td>11 (37.9)</td>
<td>9</td>
<td>11</td>
</tr>
</tbody>
</table>

*Max’s reported numbers are produced by Unni

From the quantitative summary (table 3) it can be noted that the mean number of turns needed to complete the project decreased between the different recordings. In addition, the mean time spent to accomplish the project decreased continuously for Max and Ida (Recording 1-3). As the following excerpts show, Ida is seen to take more responsibility in the unfolding local project at hand by performing the appropriate action without her interlocutor organizing the project through step-by-step instructions.
Similar to what has been noted in the projects above, all but one instance (#5) during the first recording progress through explicit directives from Max accompanied by either verbal prompts such as "press" and "arrow" or deictic gestures (see excerpt 5, lines 1 & 3). In three separate instances, at a total number of four turns, Ida is seen responding to Max's directives by requesting clarification prior to performing the suitable action.

During the second recording there are fewer instances of Max using verbal or deictic prompts in his directives. Unlike the week before, where prompts were present in five out of six project-completions, Max is only seen using prompts in the two initial instances of the recording. There are also fewer instances of Ida requesting clarification. Across the six instances, Ida is seen requesting clarification twice, compared to four times the week before. The first instance of the third recording is the only instance where Max's directive is supported by any additional prompting. That is, in the following six instances of the recording, Ida completes the project without any preceding verbal or deictic clue from Max. In addition, there is only one instance of Ida requesting clarification, and during this turn Ida completes the project prior to receiving a response from Max.

Excerpt 5, Navigating to a preceding screen, First week, Instance 1

01 M: you misclicked then you can go back ((points towards the arrow))
02 I: yea ((points towards the arrow))
03 M: =by ((retracts his hand)) pressing that arrow there
04 I: °okay° ((presses the symbol and the preceding screen appears))
05 M: there
06 I: yea

Excerpt 6, Navigating to a preceding screen, Sixth week

01 U: how do you leave here [if you want to move on how do you do that
02 I: [what did you say ((clears her throat))
03 (1.2) ((moves her hand towards the bottom of the screen)) yea
04 (2.5) it is a thing like that ((presses the arrow)) "I'll try
05 that one" °
06 U: ((nods)) °m°

In the fifth recording, the project is again initiated by Unni through an open-ended question (excerpt 6, line 1). While Ida's turn (line 2-5) is rather lengthy she is seen moving her hand to
the correct position and subsequently pressing the correct symbol without first requesting clarification or receiving any preceding verbal or deictic prompt from her interlocutor.

**Closing the application**

To close an application, one needs to press the physical home button of the iPad. We have captured this project in three recordings. In two recordings, week one and week four, the participants turned off the camera before closing the application.

**Table 4. Quantitative measures – closing the application.**

<table>
<thead>
<tr>
<th></th>
<th>Number of turns (M/I)</th>
<th>Max, Words (%)</th>
<th>Ida, Words (%)</th>
<th>Max, Words/turn</th>
<th>Ida, Words/turn</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second week</td>
<td>5 (3/2)</td>
<td>11 (84.6)</td>
<td>2 (15.4)</td>
<td>3.67</td>
<td>1</td>
<td>7s</td>
</tr>
<tr>
<td>Third week</td>
<td>5 (3/2)</td>
<td>9 (75)</td>
<td>3 (25)</td>
<td>3</td>
<td>1.5</td>
<td>5s</td>
</tr>
<tr>
<td>Sixth week*</td>
<td>2 (1/1)</td>
<td>4 (36.4)</td>
<td>7 (63.6)</td>
<td>4</td>
<td>7</td>
<td>3s</td>
</tr>
</tbody>
</table>

*Max's reported numbers are produced by Unni

As seen in the quantitative findings (table 4), the participants gradually need less time to complete the project of closing the application. Unlike the other projects, the number of turns needed to complete the project was rather low already from the start. The excerpts bellow accentuate the gradual change in interactional organization with more truncated directives from the interlocutor and more instantly executed actions from Ida.

**Excerpt 7, Closing the application, Second week**

| 01 | M: then you turn it off |
| 02 | I: m ((moves her hand back and forth across the screen)) |
| 03 | M: ((points towards the physical home button)) on the button over there you know |
| 04 | I: there ((presses the button and the application closes)) |
| 05 | M: there |

In the first recording (excerpt 7), the project is initiated by Max through the directive "then you turn it off" (line 1). Notably, Max does not use any additional verbal or deictic prompting during his initial turn. Though, after Ida responds with what could be described as a searching gesture...
(line 2), Max initiates a repair sequence and elaborates his directive by both pointing and saying "on the button over there (line 3).

**Excerpt 8, Closing the application, Third week**

01 M: and then you can turn it off  
02 I: m ((points to the physical home button)) there?  
03 M: m  
04 I: ((presses the button and the application closes)) there  
05 M: there

In the second recording, Max again initiates the project without providing any adherent verbal or deictic promptings (excerpt 8, line 1). Unlike the week before, Ida responds by immediately pointing to the physical home button and requests clarification (line 2).

**Excerpt 9, Closing the application, Sixth week**

01 U: ((Unni and Ida rise from their chairs)) we turn off now  
02 I: yea ((sits down in her chair)) you close it on that one ((presses the physical home button))

While the project is again initiated by Ida's interlocutor during the final recording. Ida now completes the project herself without either requesting clarification or receiving any verbal or deictic clues (see excerpt 9).

**Discussion**

Over the course of six weeks, several quantitative and qualitative patterns of change in the interactional organization were identified in the four reoccurring joint projects. A first quantitative pattern had to do with the fact that the time needed for the participants in the present study to complete the joint projects, at large, decreased from week to week; this finding is similar to the results reported by Clark and colleagues (e.g. [28,38,39]). A second quantitative pattern was that the participants progressively used fewer turns to complete the local project at hand. However, these quantitative findings were not as salient in the local project of unlocking the iPad. Possible reasons for this are discussed below.
Further, three distinct, and arguably related, quantitative changes were observed at the level of contributions to the joint projects. Firstly, it became clear that Max's directives gradually contained less explicit verbal and/or gestural clues. Secondly, over time Ida produced fewer requests for clarification following her interlocutor's directives. Thirdly, Ida's embodied actions towards the iPad were carried out in an increasingly more accurate and direct fashion as her searching gestures, and the gestural clues from Max, decreased.

In terms of qualitative patterns, it was obvious that the organization of the participants’ contributions to the unfolding joint projects changed over time. In our data we have identified that the joint projects continuously unfolded through a sequence consisting of the same type of contributions (see figure 1). The sequence typically starts with the cognitively healthy interlocutor initiating a joint project by producing a (i) directive. In the following turn, Ida responds with an (ii) embodied action (e.g. pressing, or pointing towards, the screen), at times accompanied with a (iii) request for clarification, (iv) something provided by Max. Ida subsequently receives (v) feedback on her conduct from the iPad (e.g. the screen lights up after the physical home button has been pressed, otherwise not), and her interlocutor who either repairs her conduct through additional clues, or confirms her action with the discourse marker “there” and thus (vi) completes the joint project.
Goodwin and Cekaite define directives as "particular constrictions and practices used for getting someone else to do something" (43,p.39). Consequently, a speaker can format directives in a multitude of ways ranging from explicit imperatives and orders, to requests, offers and hints [44]. Importantly, directives can be either verbal, embodied or a combination of both [43]. Following a directive, the next speaker's response may either be one of compliance, negotiation (e.g. requests for clarification), or rejection [34,45].

As mentioned above, every instance of the joint projects are initiated by the cognitively healthy interlocutor through a directive. Over time, Max’s directives gradually change from being explicitly deictic and accompanied by both verbal, and gestural, clues (e.g. excerpt 3, line 1-4), to being produced without any additional deictic clues (e.g. excerpt 8, line 1). Progressively, Ida’s responses become quicker and she produces fewer requests for clarification, implying that she relies more on the feedback from the iPad, i.e. whether or not her action results in the desired outcome (unlocks, returns to the preceding screen etc.).

We argue that the fact that the joint projects, over time, are completed quicker, with fewer turns, and through more implicit directives, shows that Ida requires less scaffolding from her interlocutor. Ida’s reduced need of explicit, and deictic, directives is evident in the lack of
extended negotiations following an initial directive. As such, the distance between the “expert” and the “novice” has decreased, with Ida having learned how to manage the basic functions of the iPad and the application, and thus takes more responsibility in completing the joint project [21,24].

Given the introduced theoretical framework it is obvious that Ida can learn to perform novel actions and as part of that endeavour, she can also structure what she perceives to be meaningful on the iPad in relation to what she wants to do. At the same time, her learning is limited especially in terms of being the one who initiates a project. This is something that can be related to challenges in her working memory and thus planning ability.

The main focus of studies using the intervention techniques of errorless learning, vanishing cues and spaced retrieval has been retention of declarative memories [11]. Our findings instead suggest that the changes evident in the participants’ interactional organization are due to Ida demonstrating procedural learning. The fact that Ida’s learning is predominantly procedural could explain why the quantitative measures of the fourth instance of unlocking the iPad did not follow the general pattern. Following Max’s initial directive, Ida is seen repeatedly pressing on the right-hand side of the device, where the physical home button is usually located. However, when there is no feedback from the iPad, Max identifies that the device was placed incorrectly. After rotating the device 180 degrees, Ida is able to continue with the joint project. This instance further emphasizes how the iPad functions as “a third participant” providing important feedback to both Ida and Max.

Implications

This study carries three important implications for practitioners and future research. A first implication is that we have demonstrated that novel learning is possible for people living with dementia when acting in concert with others in everyday activities, even without the use of focused interventions.
A second implication regards the fact that the novel learning was primarily procedural in nature. In our data, it seems to be the case that Ida recalled what was done rather than what was said when doing. Thus, in activities involving people living with dementia one should not underestimate the importance of doing over verbally explaining what is to be done.

Building on the two prior implications, a third implication is that practitioners do not need to worry about exposing people living with dementia to unfamiliar activities. Contrary to the theoretical underpinnings of errorless learning [12], the present study shows no instances of incorrect learning despite inadequate conduct. When Ida’s conduct is inadequate, the iPad does not respond and she either tries again or receives additional clues from her interlocutor.

To conclude, our proposed theoretical framework does seem feasible when studying learning as changing participation in everyday activities for people living with dementia. Future research should include a larger number of participants and also people living with dementia in residential care facilities.

**Declaration of Conflicting Interests**

The Authors declare that there is no conflict of interest.
References


