


Smartphones Helping Memory-Impaired Individuals Overcome Inconveniences During Daily Living

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Abstract

The external compensatory means recommended for rehabilitation of memory disorder must consist of a means for storing information externally and a clue for accessing the externally stored information. Writing down the information on a paper pocketbook is usually used as an external compensatory means, but smartphones are overwhelmingly more useful in terms of the functions as compared to paper pocketbooks. The author, who has a memory disorder and works as an occupational therapist, has recently devised a method for utilizing a smartphone for overcoming the inconveniences during daily living and herein describes how to use it in daily life scenarios.

Keywords

smartphone, memory disorders, rehabilitation, reminder, occupational therapists

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Introduction

The lead author (hereinafter, simply “author”) is a 36-year-old gentleman currently serving as an occupational therapist despite suffering from severe memory disorder as a major sequela to subarachnoid hemorrhage secondary to rupture of an anterior communicating artery aneurysm that occurred in September 2020, when he was 33 years old. Evaluation soon after the hemorrhage revealed attention deficit, memory disorder, emotional disorder, executive function disorder, and motor paralysis. At present, however, the author has no evident cognitive dysfunction or motor paralysis, and only suffers from memory disorder.

Evaluation by the Wechsler Memory Test (Japanese Version) in February 2021, 5 months after the occurrence of subarachnoid hemorrhage yielded a score of 80 for verbal memory, 50 for visual memory, 64 for general memory, 91 for attention, and 50 for delayed reproduction. The same test in April 2022, 1 year 7 months after the hemorrhage, yielded scores of 75, 71, 71, 106, and 50 for verbal memory, visual memory, general memory, attention, and delayed reproduction, respectively. At 2 years 11 months after the hemorrhage (August 2023), the corresponding scores were 76, 85, 76, 93, and 50, respectively. Thus, the results of the evaluations at 1 year 7 months and 2 years 11 months after the hemorrhage showed no marked improvement from those recorded at 5 months after the hemorrhage. The average score in

normal healthy subjects on the Wechsler Memory Test is 100, with a standard deviation of 15; that is, theoretically, the normal healthy population shows a 68.3% probability of a score between 85 and 115, 95.4% probability of a score between 70 and 130, and 99.7% probability of a score between 55 and 145. However, the author’s score for delayed reproduction (ability to remember a story that he had heard a little over 30 min ago) remained at 50 (actually less than 50) during the period from 5 months after the hemorrhage to 2 years 11 months after the hemorrhage, thus remaining in the lowest known range (probability of such a score in the normal healthy population: 0.3%).

According to a survey of daily living of individuals with cognitive impairment conducted in Japan’s capital city Tokyo (subjects: aged 47.4 ± 12.6 (18–64) years; underlying diseases: stroke 62.1%, head injury 21.1%, others 16.8%), the percentage of subjects with memory disorder requiring full assistance for Instrumental Activities of Daily Living (IADL) was 68.4% for “activities related to banks, government offices, etc.,” 44.8% for “financial control,” 31.0% for “community activities,” 27.6% for “shopping,” and 27.6% for “medication

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control (Endo et al., 2002).” This indicates that memory disorder exerts a significant adverse influence on the daily lives of these people.

Approach to Memory Disorder Rehabilitation

Rehabilitation for patients with memory disorder has conventionally been through (1) an approach toward attempting recovery of memorizing capabilities through repeated training, or (2) an approach toward elevating the daily living functions through utilization of internal compensatory means (e.g., mnemonics, mental imagery, etc.) or external compensatory means rather than through attempting recovery of the memorizing capabilities.

A systematic review-based guideline published by the Cognitive Rehabilitation Task Force of the American Congress of Rehabilitation Medicine recommends the use of external compensatory means, which can be directly applied to functional activities in rehabilitation of individuals with severe memory disorder (Cicerone et al., 2019).

The recommended external compensatory means need to consist of a means for externally storing the information and a clue for accessing the externally stored information. The former is represented by a paper pocketbook, and the latter by an alarm. Around the year 2000, studies of the use of digital devices for these means were started (e.g., McDonald et al., 2011; Wilson et al., 2001), including studies of the use of smartphones in and after 2015 (e.g., Bos et al., 2017; Evald, 2018; Ferguson et al., 2015; Jamieson et al., 2019). In these studies, the effectiveness of smartphones was evaluated using the achievement rate of specific memory-related tasks and daily living-related tasks as the endpoints.

The application (app) “Reminders app” installed on the author’s smartphone reminds the author of the relevant information at the appropriate times, and another app called the “Notes app” can store not only information in the form of letters, but also in the form of pictures, movies, voices, or pictures + letters. A memorandum noted in a pocketbook can neither accomplish the reminder function (reminding the author of the presence of the memorandum) nor has the capability of storing pictures, movies, and voices that can help in reminding an individual about forgotten scenes. Thus, in terms of functionality, smartphones surpass paper pocketbooks. Thus, it is evident that smartphones are useful. Individuals with memory disorder and their family members are seeking information on how to use smartphones in concrete scenes of daily living.

Objectives

The author, who has a memory disorder and works as an occupational therapist playing the role of elevating the daily life functions of individuals with cognitive impairment, undertook this study with the aim of devising a method for utilizing a smartphone to overcome daily life

inconveniences and describes its use in daily life scenarios.

Methods

The author wrote down inconveniences associated with memory disorder that he had experienced in daily living and devised a method for utilizing smartphone applications, etc., to overcome these inconveniences associated with memory disorder. Thereafter, he answered the preliminary questions posed by the second author who had no knowledge of the smartphone applications, and presented examples of how a smartphone can be used in a simple manner by individuals like the second author. The type of memory disorder that the author now suffers from is anterograde amnesia. For this reason, the author’s prospective memory (i.e., the ability to remember what needs to be done in the future, when it needs to be done, such as work schedules, drug intake timings, shopping that needs to be done on the way home, etc.) is markedly disturbed. However, his episodic memory for pre-hemorrhage experiences/events was largely maintained, and he can, for example, drive a car (an activity that requires procedural memory). In addition, his skills and knowledge as an occupational therapist are also preserved, allowing him to explore ways to concretely resolve any inconveniences during daily living.

The smartphone used for this study was an iPhone (iPhone XS Max, Apple Inc.).

Results

The memory disorder-related inconveniences during daily living were classified into five types, that is, inability to recall “thing,” “order,” “place,” “time,” and “matter.” Table 1 lists the five types of inconveniences during daily living, with examples of smartphone utilization to overcome each of these problems.

In regard to the utilization of the smartphone applications cited as examples in the Table 1, the author received no assistance from any other individual with normal cognitive function.

Discussion

In this section, the authors provide an explanation, as if speaking to memory-impaired individuals or their family members, about how to utilize a smartphone for overcoming five disorders of IADL identified in the survey of daily living of individuals with impaired cognition in Tokyo, taking the examples shown in Table 1.

Activities Related to Banks, Government Offices, etc.

So that a complete set of necessary documents may be brought to a bank, government office or the like, prepare a checklist of the documents needed in the smartphone’s

Table 1. Smartphones to Overcome Memory Disorder-Related Inconveniences in Daily Living.

Memory disorder-related inconveniences in daily living	How to utilize a smartphone to overcome the inconveniences *Terms such as Thing 1 and Time 2 correspond to those used in the Discussion section
<i>Inconveniences arising from inability to recall things</i>	
Duplicate purchase of foodstuff already available at home because of inability to recall	Before shopping, check the items available at home and those that need to be bought and enter the latter into your smartphone's Notes app. The Notes app is equipped with a checklist preparing function. So, every time you place an item into your shopping basket at the shop, place a check mark against it in the Notes app (Thing 1). Use of this checklist function can lead to avoidance of duplicate purchases, while simultaneously also ensuring that you purchase all the things that you had planned to buy.
Unable to recall what needs to be carried when going out	Write the name of the destination on a white board, and place the things that you need to carry near the white board. Then, take a photograph of these with a smartphone.
<i>Inconveniences arising from inability to recall an order</i>	
Getting lost when going to a new workplace that is 6 min away by foot and 2 min away by bicycle	Register your home and workplace on your smartphone's Google Maps app. Follow the voice navigation by this app when going to the workplace and returning home.
When visiting a destination by car for the first time, the route is unclear, causing anxiety about the ability to reach the destination smoothly (car driving uses the procedural memory acquired before the onset of subarachnoid hemorrhage and is therefore possible under author's current condition characterized by anterograde amnesia).	You can feel reassured if you take the following steps in advance: Set the destination on the smartphone's Google Street View within the Google Maps app. Then, simulate the route many times (Order 1). On the day of trip, follow the voice navigation by the Google Maps app to reach the destination (Order 2).
<i>Inconveniences arising from inability to recall a place</i>	
After shopping at a large supermarket, unable to remember where the car was parked and difficulty in finding the car	Place the loss prevention tracker Apple AirTag in the car before parking, and the smartphone's Find My app will guide you to the car after you have finished shopping (Place 1). Record an aerial photograph in the Google Maps app with your smartphone's Screenshot app, and mark the line of flow from the parking place to the shop entrance on the photograph using the manual writing function of Markup app. If you take the following photographs (1) through (3) in advance, they will help you find the exit to the parking place after shopping and return smoothly to the parking place. (1) Take a photograph of a landmark in the parking place (e.g., 4F A2) and your car with a smartphone. (2) Take a photograph of the entrance to the shop with a smartphone. (3) Take several photographs of the name and the distinct parts of the department closest to the entrance with your smartphone. This department could serve as a landmark to guide you back to your parking place.
<i>Inconveniences from inability to recall time</i>	
Unable to concentrate on the job because of concerns with the schedule for a given day	If you register the schedule and the timings in advance on the smartphone's Reminders app, the smartwatch linked to the smartphone will vibrate at the set times (Time 1). The screen will also display "Now the time for xxx." It is also possible to set it so that the linked smartwatch will vibrate as a reminder 30 min before the scheduled time (Time 2).
Unable to recall the time for medication	Use the smartphone's Reminders app to set the time for drug intake (at 07:00 hr if it is to be taken with breakfast at 7:00 a.m. and 19:00 hr if it is to be taken with supper at 7:00 p.m.). The linked smartwatch will vibrate at the set time while the screen will display "drug intake" (Time 3). If you need to take different drugs at different times, the app can be set to display "drug intake" on the mobile phone screen at the indicated time, followed by parentheses "(" indicating the name of the drug to be taken: "drug intake (xxxx)."
<i>Inconveniences arising from inability to recall matters</i>	
Unable to recall what has been bought and also the fact of having made purchase	If the smartphone-based settlement using a credit card is utilized, the history of merchandise purchase is left in the smartphone, showing you what was bought and when. An upper limit of expenditure can be set, helping you avoid impulse purchase (Matter 1). If a credit card is shared with family members, the status of card use can also be checked by the family members (Matter 2).

(continued)

Table 1. (continued)

Unable to recall what has been explained at a government office or the like	Record important information on the smartphone's Voice Memos app after obtaining the consent of the staff member involved (Matter 3).
Feel anxious about being unable to recall a trouble like a traffic accident	Record the scene with your smartphone's Screenshot app and record the circumstances with the Notes app to eliminate anxiety (Matter 4).
Fluid control is needed because of hypertension, but unable to recall the amount of fluid taken on a given day.	Use the smartphone's Water Reminder app. On the list of water volumes (200 mL, 300 mL, etc.) displayed on the app, tap on the volume you take each time, which will result in addition of the ingested water volume to the record and show the water volume taken on a given day.

Note. Notes app, Find My app, Screenshot, Markup app, Reminders app, Voice Memos app: Standard applications. Google Maps app, Water Reminder app: Applications installed by the author. Google Street View: A function built in the Google Maps app. All of these applications are free of charge.

Notes app and place a checkmark against each document that has been placed in the bag before departure (Thing 1). Set the departure time from home in the smartphone's Reminders app, together with the purpose of the visit. If these have been done, the smartphone or the linked smartwatch will announce them through a voice message or vibration (Time 1). The need to depart in a hurry could be avoided if you set the Reminders app to make the announcement 30 min before the planned departure (Time 2). If you have to go to a place that you have never visited before, it is advisable to set the destination in the smartphone's Google Street View within the Google Maps app, accompanied by prior checking of the route to the destination and simulation of the trip (Order 1). On the day of actual trip, the trip will be smooth if you follow the voice navigation function of the Google Maps app (Order 2). To search for the place at which you have parked your car, placing the loss prevention tracker Apple AirTag in the car in advance will be useful (Place 1). If the staff member at the bank, government office or the like speaks too fast to allow you to prepare a memorandum or speaks about particularly important matters, it would be advisable to record the talk on the smartphone's Voice Memos app after obtaining the consent of the staff concerned (Matter 3). After your business with the bank, government office or the like is over, you may be guided to the AirTag placed in the car by the smartphone's Find My app. The car driving route back home will be announced by the voice navigation of the Google Maps app in the same way as on the outward journey (Order 2).

Financial Control

If you utilize the smartphone settlement with a credit card with a preset limit for payment, you can check at a glance what you have shopped for and when you have shopped (Matter 1). If needed, you can also share a credit card among family members, allowing each member to check the status of its use (Matter 2).

Community Activities

To avoid absence from a community meeting, you may use the smartphone's Reminders app, setting the time

and objective of the meeting for subsequent reminder by the smartphone or the linked smartwatch (Time 1). Important talks during the meeting could be recorded with the smartphone's Voice Memos app after obtaining the consent of the members concerned (Matter 3). If you are anxious about possible violation of the community's daily rules on garbage disposal, etc., you could take photographs of the garbage you have taken out with the smartphone's Screenshot app, while also recording the date and time you took the garbage out using the Notes app (Matter 4).

Shopping

To avoid buying anything which you already have, you can make a note of what you are going to purchase in a purchase list (with a check space attached) on the smartphone's Notes app. Every time you place an item into your shopping basket at the shop, you should place a check mark against the item on the list to make it clear that it has been purchased (Thing 1). This would lead to avoidance of duplicate purchases, while simultaneously also ensuring that you purchase all the things that you had planned to buy.

Medication Control

You can use the smartphone's Reminders app also for managing your medications. If you plan to take breakfast at 7:00 a.m., you can set "drug intake" at 07:00 hr. If you plan to take supper at 7:00 p.m., you can set "drug intake" at 19:00 hr. These actions would lead the smartphone or the linked smartwatch to vibrate at the set time, with the screen displaying "drug intake" (Time 3). If you need to take different drugs at different times, the app can be set to display "drug intake" on the smartphone screen at the indicated time, followed by parentheses "("") indicating the name of the drug to be taken: "drug intake (xxxx)."

Conclusions

The most commonly used memory tests around the world are the Wechsler Memory Test and the Rivermead

Behavioral Memory Test (RBMT). In 1991, Wilson, who developed the RBMT reported that about a half of the individuals with severe memory disorder, whose RBMT scores changed little over a long period of time after the end of training, were leading daily lives with compensatory means for memory disorder that they had learned. External compensation for memory disorder requires a means for external storage of information and clues for reminding the memory-impaired individual to access the externally stored information. Smartphones are equipped not only with the function of reminding the user of the available information at the correct times, but also with the function of storing the information in the forms of letters, photos, movies, voice messages, and photo + letter combinations. Smartphones with these functions serve as a rather valid tool for compensating for memory disorder. During the early days after discharge from the hospital, the author often repeated toothbrushing, body washing, without the awareness that these activities had already been performed. The scores on the Wechsler Memory Test have not changed much from the scores in those early days, but the author now suffers no inconveniences in terms of the basic ADL (activities of daily living such as eating, dressing, toileting, bathing and grooming). Making use of a smartphone, the author resumed his work as an occupational therapist in January 2024 and is now also providing home visit rehabilitation services as an occupational therapist. According to a statistical survey conducted in Japan in 2021, 86.8% of the total population, 99.3% of persons aged 30 to 39 years, and 71.7% of persons aged 70 to 79 years possess at least one smartphone (Digital Agency, 2021). Now, on a global scale, there is a trend for the advent of a society in which many people possess smartphones. Smartphones serve as a tool that can greatly improve the quality of life (QOL) of memory-impaired individuals. It is now essential to devise ways for memory-impaired individuals to put their smartphones to use during daily living and to disperse such information.

Limitations and Open Issues

Memory disorder is often associated with dementia (e.g., Alzheimer's disease), cerebrovascular disease, advanced age, etc. The usefulness of smartphone manipulations could be limited by the etiology, associated complications, and severity of the memory disorder. The ability for smartphone manipulations can also be affected by visual disorders associated with ophthalmic diseases, and hand/finger pain and deformities associated with chronic rheumatoid arthritis, etc. The availability of assistance providers to guide memory-impaired individuals for smartphone manipulations and the level of patience of these providers can also affect the capability of memory-impaired individuals to use smartphones. Finally, the economic burden posed by the need to purchase a smartphone is also an issue that still remains unresolved.

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Ethical Approvals

This study was conducted with the approval of the Research Ethics Committee of University of Kochi and also by the Social Welfare Research Ethics Committee of University of Kochi (Approval number: 22-35).

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