Predicting Uptake of the Digital Memory Notebook based on Competency

Parveer Kaur[1], Fiona Keogh[2], Katelyn Brown[3] & Maureen Schmitter-Edgecombe[3]

[1]Dartmouth College, [2]Pullman High School, [3]Washington State University

Introduction

Background:

- More than 16 million people in the US are living with cognitive impairment, which can negatively impact ability to complete activities of daily living (e.g., meal preparation, managing medications) and decrease self-efficacy.[1]
- Paper and pencil memory notebooks can support everyday memory, serving as an external aid. However, these traditional formats can be difficult to learn and navigate.
- Advances in technology allow for more effective design of compensatory strategy tools to help individuals with memory loss preserve functional independence.
- The Digital Memory Notebook (DMN) is an iOS application, iteratively developed by our group as an "all-in-one" memory aid and organization tool to aid cognitively impaired older individuals.

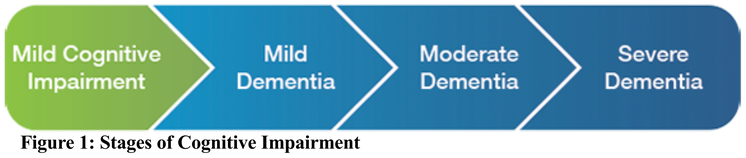

Figure 1: Stages of Cognitive Impairment

Objectives:

- Examine how individuals with Mild Cognitive Impairment (MCI), a transitional phase between normal aging and dementia, respond to learning to use the DMN application.
- Examine and quantify continued use patterns of the DMN by individuals during a 3-week post-training period.
- Identify characteristics of individuals who demonstrate low and high uptake of the intervention.

Application

- To optimize the usability and functionality of the app, the design process was guided by cognitive rehabilitation principles.[2]
- The DMN intervention consists of didactics and skills training between the clinician and participant over a period of five sessions, each lasting around 120 min, and are completed within a one-month time frame. Flexibility is built in so clinicians can individualize the pace of the intervention to fit the client's skill level, comfort with technology, and comprehension of material.[2]

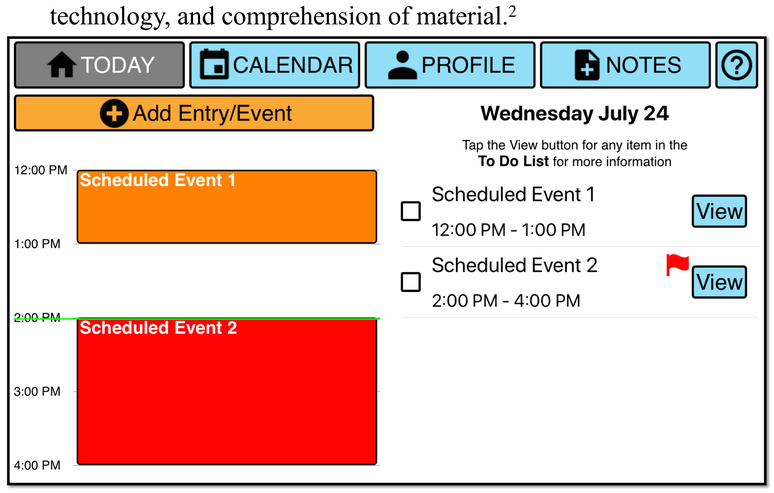

Figure 2: Image of DMN Home Page. It has five main pages (i.e., Today or Home page, Calendar, Profile, Notes, and Help) and a sub-component accessible by the Today page (i.e., Add Task/ Event).

Methods

Participants: 19 individuals with MCI from Eastern Washington

Table 1: Background characteristics of the study participants

Age		Education		% Female
Mean (SD)	Range	Mean (SD)	Range	
71.84 (6.65)	65-81	16.16 (1.74)	14-18	36.84 %

Protocol:

- Prior to the DMN intervention, participants were administered a battery of neuropsychological tests to characterize cognitive abilities.

Table 2: Cognitive measures and their definitions.

Premorbid Ability	Estimate of intellectual functioning prior to onset
Immediate Memory	Ability to remember information immediately after presented
Visuospatial	Ability to perceive spatial relations and to construct a spatially accurate copy of a drawing
Language	Ability to name objects and quickly produce words
Attention	Capacity to manipulate visually and orally presented information in short-term memory
Delayed Memory	Ability to retain information after a time delay (20 minutes)
Executive	Quickly produce words beginning with specified letters
Executive	Ability to inhibit repeating responses while generating novel designs as quickly as possible

- The DMN intervention was then administered and mastery of DMN components was recorded by clinician ratings each session.
- Competency Ratings were determined on a Likert scale (1 -7) and consisted of the following questions:

1. How skillfully did the participant perform the following behaviors?
2. Did the participant understand the concepts related to the DMN presented during the session?
3. How motivated was the participant throughout the session?
4. How motivated does the participant appear to be about learning and using the DMN app?

- Grouping Criteria: Low mastery = ratings avg. ≤ 5 for competency; High mastery = ratings avg. > 5. High mastery for competency but low motivation (ratings avg. ≤ 5) was also placed in the general low uptake group resulting in 7 participants in the low uptake group and 12 participants in the high uptake group.
- We then examined differences in DMN usage for the three weeks post training between clinician rated low and high mastery groups.

Table 3: Key DMN Variables and Definitions

Total Taps	Variable keeps track of and adds together all of the user's taps on the application. This does not register keyboard taps
Total Distinct Uses	Variable represents how many times the DMN is used at distinct times. Distinct use is defined as 5 minutes of inactivity.
Total Event Interactions	Variable represents how many times a user interacted with any event in any way (Created, Edited, Completed, or Deleted).

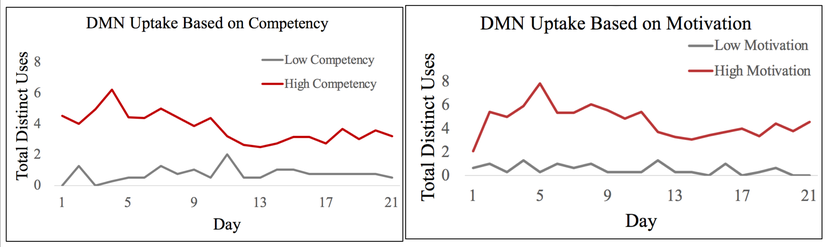

Figure 4: Graphs of Uptake Based on Competency for Total Distinct Uses (L) followed by the High Competency Group separated on Motivation (R). Similar trends also present for other DMN metrics.

- The Instrumental Activities of Daily Living- Compensation (IADL-C) and the Prospective Retrospective Memory Questionnaire (PRMQ) were administered to participants and a knowledgeable informant to capture everyday functioning difficulties and everyday memory lapses.

Acknowledgments

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Results

Based on the groups shown in Table 3, T-tests were conducted to examine for group differences in the DMN variables, cognitive measures, and functional questionnaire data.

Table 4: Background Characteristics of Uptake Groups for Statistical Analysis

	Age		Education	
	Mean (SD)	T-value	Mean (SD)	T-value
Low Uptake	70.17 (6.70)	-1.54	16.00 (1.75)	-.503
High Uptake	74.71 (5.93)		16.42 (1.81)	

Table 5: T-tests between DMN metrics and the Uptake Groups

DMN Metric	High Uptake Mean (SD)	Low Uptake Mean (SD)	T-value	Effect Size
Total Taps	59.22 (64.14)	18.61 (30.39)	**1.86***	.81
Total Distinct Uses	4.33 (4.33)	.77 (.92)	**2.81*****	1.14
Total Event Interactions	11.51 (12.96)	2.69 (3.90)	**2.19****	.92

Table 6 : T-tests between Cognitive Measures and the Uptake Groups

Cognitive Measures	High Uptake Mean (SD)	Low Uptake Mean (SD)	T-value	Effect Size
Premorbid	106.33 (11.31)	116.0 (7.02)	**-2.30***	-1.02
Immediate Memory	88.50 (14.50)	73.29 (12.98)	**2.36***	1.11
Visuospatial	104.25 (15.74)	91.14 (18.47)	1.57	.76
Language	94.75 (10.60)	86.43 (20.64)	.99	.51
Attention	90.00 (15.93)	101.14 (15.72)	1.48	.70
Delayed Memory	86.17 (14.69)	67.86 (16.84)	**2.39 ***	1.16
Letter Fluency	9.33 (2.93)	11.57 (3.46)	-1.50	.70
Design Fluency	10.00 (2.79)	10.85 (4.29)	-4.72	.24

Table 7: T-tests between Functional Measures and the Uptake Groups

Functional Measures	High Uptake Mean (SD)	Low Uptake Mean (SD)	T-value	Effect Size
IADL-C	63.62 (24.15)	73.58 (34.43)	-.70	.40
KI IADL-C	64.10 (22.19)	102.63 (24.27)	**-3.17****	1.66
PRMQ	46.82 (6.05)	46.71 (10.06)	.03	.013
KI PRMQ	41.36 (10.44)	51.86 (6.08)	**-2.62***	1.23

*p < .05 ; ** p < .01; *** p < .005

- In Table 5, despite having higher premorbid abilities, the immediate and delayed memory scores of the low uptake group are more impaired than the high uptake.
- In Table 6, significant group differences from the questionnaires completed by the knowledgeable informant compared to self is indicative of a lack of awareness from the MCI participants in the low uptake group about the level of difficulty they are experiencing with everyday tasks.

Conclusion

- Post intervention usage patterns of the DMN were accurately predicted by competency ratings performed by clinicians, with both low competency and poor motivation leading to lower use of the DMN as an external aid to assist with everyday functioning.
- The low uptake group demonstrated poorer memory abilities as well as a lack of insight for level of difficulty experienced when compared to the high uptake group.
- This study will allow us to better identify individuals who are likely to benefit from the DMN intervention as the high uptake group is seen using the DMN at least 4 distinct times a day one month following training.

References

1. Family Caregiver Alliance. www.caregiver.org/caregiver/jsp/content_node.jsp?nodeid=438.
2. N. Raghunath, J. Dahmen, K. Brown, D. Cook & M. Schmitter-Edgecombe (2019) Creating a digital memory notebook application for individuals with mild cognitive impairment to support everyday functioning, Disability and Rehabilitation: Assistive Technology