

Does Taking Notes Help You Remember Better? Exploring How Note Taking Relates to Memory

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ABSTRACT

People are aware of the fact that their memories are fallible and as a result they spend significant amounts of time preparing for subsequent memory challenges, e.g. by taking notes about information they think they will later have to remember. There has been extensive research into note taking and whether it is effective as a memory aid, but most of this has concerned pen and paper rather than digital notes. We conducted an experiment investigating the relationship between note-taking behaviors (whether digital or paper based) and subsequent recall. We gave people two systems: a note-taking device called ChittyChatty (CC) that combines digital notes with an audio record – Fig 1; and conventional Pen & Paper (PP) – Fig 2. We observed the note taking patterns that occurred in digital CC notes and paper based PP notes. We then examined whether the quality and quantity of those notes related to subsequent organic memory (OM) – i.e. human memory without any external aids. We also explored people's perceptions of the accuracy of their OM, in relation to the quality and quantity of their CC and PP notes, to see whether people who believed they had bad memories took more notes.

Overall, we found that taking high quality notes helped OM, but taking large volumes of notes didn't. This disconfirms the Distraction hypothesis which claims that the act of taking notes leads people to remember less using OM at recall. We also found a close correspondence between digital and pen and paper notes. Finally people who are unconfident about OM tend to take more notes, suggesting that these people may overcompensate when taking notes, because of their perception of their poor OM quality.

Categories and Subject Descriptors

D.m [Software]: Software Psychology.

General Terms

Performance, Design, Experimentation, Human Factors.

Keywords

Memory, Prosthetic Memory, Digital Memory, Notes, Handwritten Notes, Speech Retrieval, Speech Browsing, Remembering.

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1. INTRODUCTION AND MAIN QUESTIONS

In our everyday lives we are aware of the fallibility of our memories. To prepare for future retrieval we carry notepads, diaries and other writing devices to help us remember information that we may need to recall in the future. In this paper we refer to the use of such prosthetic devices as prosthetic memory (PM), and natural unaided memory as organic memory (OM). However, there is much that we don't know about the utility of PM devices: are digital notes similar ways to pen/paper notes? Do people who think they can't remember tend to take more notes? And does note taking distract us from remembering using OM?



Figure 1. ChittyChatty (CC) Interface – temporal co-indexing of notes and audio.

Note taking to most of us is a conventional way of life. We think we know how to take notes, and we believe that it's one of the oldest and most efficient external human memory aids known to mankind [1]. But do such PM notes aid our OM in general and in the longer-term? Some research studies suggest that notes are only effective as a short-term memory aid [7].

Research into note taking has been extensive [7, 6, 8, 4], however, most of this work has focused on when and why people take *paper* notes. And another crucial issue that has not been systematically explored is the relationship between the quality and quantity of digital notes that people take and how it influences our organic memory (OM).

Here we describe a study investigating the effects of note taking patterns on OM. In particular, does note *quality* or *quantity* affect our ability to recall information more accurately using OM? And how do notes help us remember? Do they promote better OM, or do they help us prosthetically by providing a record of the information that we need to know?



Figure 2. Pen & Paper (PP)

We describe a laboratory study investigating two general note taking attributes relating to OM and PM: (a) *Quality* of PM notes; (b) *Quantity* of PM notes; looking at how these relate to (c) *Memory Performance* (whether using OM, or PM) and (d) *Confidence* in OM. We had four main research questions: first, what is the relationship between digital and pen/paper notes? Second, do people who take high *Quality* or *Quantity* notes, perform better at OM recall, or does note taking generally distract them? Third, when people take high *Quality* or *Quantity* notes, does that help remembering with PM? Fourth, what is the relationship between *User Confidence* in their own OM and note *Quality/Quantity*?

Specific questions we address are:

1. Are digital and paper notes similar or different?
2. Does the act of taking notes distract people from focusing on important information - preventing them from later remembering unaided?
3. Does note-taking help people by successfully recording information they need later thus improving PM recall?
4. How does the quality and quantity of individual notes relate to people's perception of the accuracy of their OM? E.g. do people who are confident about their OM take fewer notes?

2. EXPERIMENTAL METHOD

The data for this paper was collected during an experiment investigating relationships between OM and PM [3]. This paper presents further results examining how the *quality* and *quantity* of collected notes affects OM. We applied the following procedure.

Briefly in our within subjects experiment people were given memory tasks where they heard a conversation, and were given a specific memory prosthesis. This PM was either traditional pen-and-paper (PP) or digital ChittyChatty (CC) – a device that coindexes a speech recording and digital notes. People could use this prosthetic device to take notes while they listened to the conversation.

They were later asked to remember details of that conversation, and given access to the original notes they had taken when they first heard the story. Of course some users could remember parts of what had been said without needing to refer to their notes, and users were free to choose whether to use their unaided OM or PM notes to answer questions. We also recorded users' confidence in their OM, by asking them before each retrieval question, how sure they were that they would be able to remember information

unaided, i.e. without recourse to the PM device they had been given.

We also recorded the preparations that they made for future retrieval by analysing the notes they made either on paper or using CC.

2.1 Users

In total we had twenty five users who took part (14 women and 11 men, aged 23-55). Users were volunteers consisting of university researchers, administrative and management staff, as well as other professionals from public and private sectors. Users had no prior knowledge of the project or our experimental hypotheses. None of the users had prior experience of using CC, but obviously all had extensive experience both OM and PP.

2.2 Procedure

The experiments were run using a custom built website. Users were first given a general description of the experiment, and the conversations. We then gave them a brief web-based, hands-on tutorial providing detailed descriptions of each memory prosthesis and procedures for the experiment. Users were allowed to proceed to the actual experiment only if (a) they felt confident with each PM and (b) they had successfully completed all practice tasks.

The experiment ran across 3 sessions: same day, 7 days later and 30 days later. On the first day, users took notes and had to recall information they just heard. 7 and 30 days later, users were asked to retrieve information they heard on the first day. They were allowed to use their notes to answer questions, but they could also choose to rely for memory on their OM alone. Thus at retrieval we had some data for when people used OM only and other data for when they relied on PM (whether this was PP or CC notes).

2.3 Stories and Test Questions

The conversational stories were intended to simulate real-life conversations between two old friends who had just bumped into one another after a period of several years. The stories contained a mixture of facts and fiction equally distributed within each story. We conducted extensive pilots with the stories, to ensure they could be easily understood; they did not contain any unfamiliar or unusual terms. User comments indicated that they were enjoyable to listen to, as well as achieving their objective of simulating real-life conversational experiences. The average story time was 3.20 minutes.

An example fragment of one story was the following:

"Oh, do you remember my older brother, Dave? Let me tell you how he got here. He has loved Def Leppard ever since he was 15 years old and saw them play at the Sheffield Show, Hillsborough Park in 1978. The hair, the tight trousers, the heavy guitars, the thunder of the drums and the screaming vocals. He was particularly entranced with their Yorkshire lyrics."

We read users a story and gave them either CC or PP depending on the experimental condition. To control for story/retrieval method confounds, we counterbalanced the order in which users received stories, and the PM they were given. Users answered questions on web based forms.

In all conditions we recorded the *retrieval accuracy*, scored by two independent judges against a formal marking scheme. People could choose to answer questions using their PM notes or unaided OM, and we recorded whether users relied on OM or PM to answer the question.

The *quality* of notes was scored in the following way. We first generated an evaluation metric for the quality of the notes, by

having two coders blind to the experimental hypotheses. They agreed a set of ideal notes. We then scored notes against the target. Quality scores ranged from 0-5 depending on how much of the target notes the user generated. If the note contained all the target keywords (or their synonyms) and context, it received a maximum score of 5. Partial scores for quality were defined as either (a) containing all keywords, but not enough or inaccurate context, or (b) accurate context, but incomplete set of keywords. Scoring was carried out independently by the two scorers and disagreements were referred to a third scorer for resolution.

The *quantity* of notes was scored on the basis of the number of words written on the screen or paper. This count captured all the words written down, but excluded articles and other non-meaningful words. Fig 3 & 4 illustrate the difference between high and low quantity of notes taken with CC.

3. HYPOTHESES AND RESULTS

The results are organised as follows:

- H1 – Equivalence Hypothesis – people will take similar *Quality* and *Quantity* notes with CC and (PP).
- H2 - Distraction Hypothesis – the act of taking notes distracts - causing people who take detailed notes to remember less using OM.
- H3 – PM Capture Hypothesis – notes provide an important resource for memory, and detailed notes will result in better PM retrieval.
- H4 – Confidence Hypothesis – people who are confident about own memory take less notes.

3.1 Measures and Variables

We collected and report the following data:

- Note *Quality* for CC and PP
- *Quantity* of notes for CC and PP
- User *Confidence* in their ability to remember unaided
- *Accuracy* of answers and whether these are generated using OM or PM

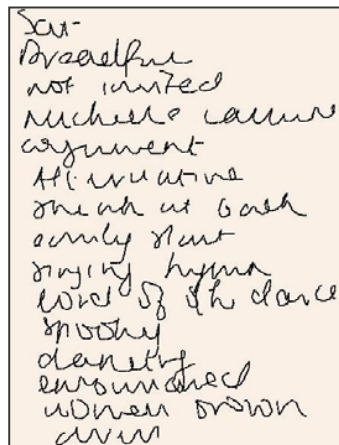
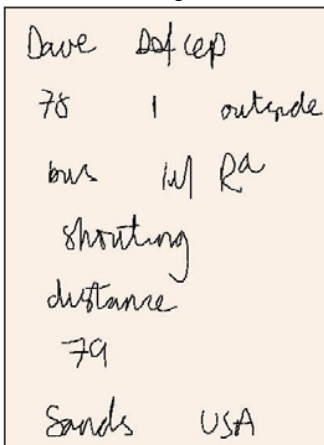


Figure 3. Low Quantity of CC Notes.

Figure 4. High Quantity of CC Notes.

3.2 Equivalence Hypothesis

Are CC and PP notes similar or different?

We were interested in how people took notes digitally compared with pen and paper notes. For instance, when people used CC, did they take more or less notes, in comparison to when they used PP?

We found that notes were consistent in *Quality*, digitally and on paper. There was a strong correlation between the *Quality* of digital notes on CC and PP notes ($r(1, 24) = 0.4, p < 0.01$).

The *Quantity* of CC & PP notes was also consistent. There was a strong correlation between the *Quantity* of both types of notes ($r(1, 24) = 0.6, p < 0.01$).

Furthermore, we examined normalised *Quality* and *Quantity* results, where we calculated the number of high *Quality* notes as a function of the number of notes taken. Again we found a strong correlation between CC normalised note scores and PP normalised note scores ($r(1, 24) = 0.5, p < 0.01$).

Given this similarity between digital and PP notes, we therefore combine them in the following analyses.

3.3 Distraction Hypothesis

Do high Quality and Quantity notes help OM?

We first evaluate the objective benefits of *Quality* and *Quantity* notes on the *Accuracy* of user answers using OM.

We correlated OM *Accuracy* scores (when people chose to use their OM to answer questions) with overall *Quality* of CC & PP notes combined. We found a positive correlation ($r(1,24) = 0.4, p < 0.01$). Thus, people who take higher *Quality* notes, generally have better OM. So contrary to the Distraction hypothesis, taking high quality notes doesn't distract people from OM remembering. Instead, if they take good notes they tend to remember better. This suggests that notes may function to reinforce information being committed to OM, by helping people to focus on what is important to remember.

There was no correlation between the *Quantity* of combined CC & PP notes and OM *Accuracy* ($r(1, 24) = 0.07, p > 0.1$). Thus the sheer volume of notes is unrelated to OM.

3.4 PM Capture Hypothesis

Do more detailed notes increase PM accuracy?

We next tested whether more detailed notes help people to retrieve information more accurately when they use PM. We looked at the correlation between the *Quantity* of PM notes and *Accuracy* when people answered questions using PM. There was no correlation between PM note *Quantity* and PM *Accuracy* scores ($r(1,24) = 0.1, p > 0.1$). Thus people who take more detailed notes, do not do better at PM recall. This may be because notes become hard to interpret especially at longer retention intervals of a week or month [3].

3.5 Confidence Hypothesis

Does high user Confidence result in low Quantity of notes?

Overall people can remember the amount of notes they generated in a short-term, e.g. during the same session. A week or a month later, people may be unable to remember details of notes that they generated during the first session. We therefore conducted analysis of user confidence during the first session alone.

We found a strong negative correlation between the *Quantity* of PM notes and user *Confidence* score during the first session ($r(1, 24) = -0.5, p < 0.05$). This suggests that people take more notes if they are not confident that they can remember using their OM.

4. CONCLUSIONS

There is some controversy surrounding PP notes. Some researchers have argued that PP notes are little use as a memory aid [4, 8], while others suggest they are useful [6]. We examined whether there are any specific features of PP (and also CC) notes that influence OM.

One of the most popular theories expounded to disprove the effectiveness of notes is the Distraction Hypothesis [2,7] which claims that people miss (and therefore forget) vital information because they are busy writing what was being said. Our research results don't support this hypothesis, showing instead that high quality notes *help* OM. This may be because taking good notes helps people to focus on what is important. However we also found that note-taking was motivated by people's evaluation of their OM. People take more notes when they are less confident about their OM, suggesting that they may be concerned about being distracted, and overcompensate for this.

We expected users with more notes to be able to overcome potential OM weakness by 'reading off' the answers from their notes. Somewhat surprisingly we did not find a relationship between note quantity and PM accuracy. This may be because at longer retention intervals the cryptic nature of most notes and the fact that they do not capture information such as emotions, background setting or context, makes them increasingly hard to interpret.

In addition we observed consistency between digital and paper based notes. Generally, when a user generates a lot of notes with PP, they will also tend to generate a lot of notes with CC. Similarly with quality, users who generate high quality notes on PP also tend to generate high quality notes with CC.

However it may be that if people used CC more regularly and over longer periods of time, this strong overlap between CC and PP notes may decrease. Another independent analysis of long

term note taking with CC, suggests people shift to more minimal ways of note taking relying on speech for retrieval.

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