The Effects of Domain Knowledge and Concept Map on Processing and Memory for Hypertension-related Text

Xuefei Gao[1], Sven Bertel[2], Jessie Chin[1], Anna Madison[1], Daniel G. Morrow[1], Elizabeth A.L. Stine-Morrow[1], Yusuke Yamani[3], Thembi Conner-Garcia[4], James F. Graumlich[4] and Michael D. Murray[5]

[1]Beckman Institute and Department of Educational Psychology, University of Illinois at Urbana-Champaign, Urbana, IL; [2]Computer Science and Media, Bauhaus-University Weimar, Weimar , Germany; [3]Department of Psychology, University of Illinois at Urbana-Champaign, Urbana, IL; [4]Internal Medicine, University of Illinois College of Medicine at Peoria, Peoria, IL; [5]College of Pharmacy, Purdue University and Regenstrief Institute, Indianapolis, IN

INTRODUCTION

- Older adults with chronic illness often do not understand the information they need for self-care, in part because of inadequate health literacy and broader cognitive limits related to processing capacity (Chin et al., 2011). However, they may leverage internal resources (knowledge) and external resources (external aids) to help offset these limits and support comprehension. A *concept map* (CM) is an aid often used in the classroom to support learning, but is rarely used in patient education. Little is known about the effect of CMs on older adults' comprehension.
- The effects of CM may be moderated by older adults' knowledge. On the one hand, older as well as younger adults with low knowledge may benefit the most from CMs (see Nesbit & Adesope, 2006 for a meta-analysis) that explicitly signal relationships among key concepts, thereby reducing the need for knowledge to understand the text (Mayer, 2001). On the other hand, CMs may scaffold older adults' use of knowledge during comprehension. Older adults can benefit from knowledge when reading, but they must expend more cognitive effort to do so (Miller et al., 2004). In an earlier study, we used eye-tracking to examine how older adults who varied in health-related knowledge used pictures to support comprehension of health texts (Morrow et al., 2012). Older adults with more knowledge better understood the passages, and were also more likely to look at the picture after first reading the text (Morrow et al., 2012). In the present study, older adults with more knowledge may benefit more from CMs than those with less knowledge.
- To investigate whether CMs improve comprehension because they are structured (depict relationships among concepts in the text), we also included an unstructured control graphic that simply listed the same concepts.

METHODS

Participants

- 52 Community-dwelling older adults participated (M_{age}=69.7, range=60-93 years; $M_{education}$=15.3, range=12-18 years).
- They varied in knowledge about hypertension (Hypertension Knowledge Questionnaire or HTK, Chin et al., 2011; *M*=29.9, range=23-37).
- 52% were diagnosed with hypertension.

Materials and Design

- Nine hypertension-related passages were created based on information from publically accessible websites (e.g., NIH, AHA). Each passage contained text presented either with a CM (structured aid, which highlighted the organization of important text concepts), a matched concept list (CL, unstructured aid, which contained the concepts identical to those in CM without the organization), or no aid (see Figure 1).

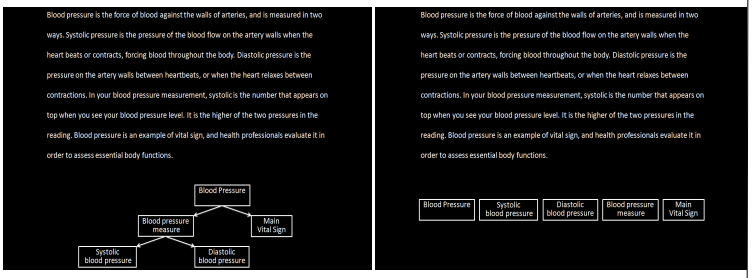

Figure 1. Figure 1. Example of stimuli in concept map and concept list

Procedure

- Participants completed the HTK questionnaire.
- They then read three passages with CM, three with CL, and three without an aid, and eye-movements were tracked in order to measure online comprehension processes.
- They completed a cued recall test for passage information after all 9 passages were presented.

RESULTS

- *Cued recall*

Hierarchical linear modeling was used to analyze the measures of recall and reading time; z-values for coefficients are reported.

We first examined how well participants remembered the passages. Cued recall was analyzed in a hierarchical linear model with health knowledge and passage condition (CM, CL vs. text only) as predictors in a full model (i.e., with all the main effects and interactions). Higher-knowledge participants remembered more passage information, z=2.52, p=.01, and this effect was exaggerated by the presence of either graphic aid, z=3.80, p<.001 (see Figure 2). Both graphic aids increased recall for the high-knowledge, z=2.44, p<.05, but not the low-knowledge participants, z<1. There were no systematic differences between two graphic aid conditions, z<1 .

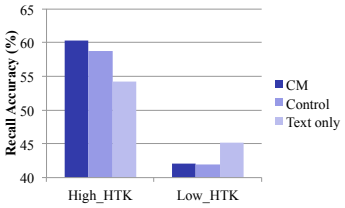

Figure 2. The effects of knowledge and graphic aids on cued recall

- *Eye-movement measures*

In order to understand why only the high-knowledge participants benefited from the graphic aids, we analyzed the effect of knowledge on the proportion of time spent viewing the graphic aids in relation to the total amount of time (time spent on both text and aid) for each trial.

- The higher-knowledge individuals spent more time viewing both the CM and the CL compared to the lower-knowledge counterparts, z=3.19, p<.001. Participants tended to spend a greater proportion of time inspecting the CM than the CL for both knowledge groups, z=6.50, p<.001 (see Figure 3).

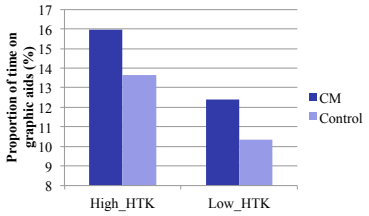

Figure 3. The effect of knowledge on time spent on graphic aids (in percentage)

- *Knowledge, study time allocation and cued recall*

To more fully understand the impact of health knowledge and processing strategy on passage recall, we conducted another hierarchical linear modeling analysis with three predictors, i.e., Aid (CM, CL), Study time (proportion of time spent on the graphics in relation to the text), and Knowledge entered in the full model. Both knowledge and time viewing the graphic aids were independent predictors of cued recall, z=4.58, p<.001; z=2.47, p=.01, respectively. Again, there were no systematic differences between two graphic aid conditions in this analysis.

CONCLUSIONS

- Older adults with more health knowledge took greater advantage of the graphic aids: they spent more time viewing the CM and the CL and they better recalled the passages. This suggests that older adults' prior knowledge facilitates further learning about health topics (Beier & Ackerman, 2005), and graphic aids may further improve recall by scaffolding knowledge use during comprehension (e.g., making it easier to use knowledge structures to integrate concepts in the text; also see Morrow et al, 2012).

- These findings suggested that a) domain knowledge could be a constraining factor for older adults in optimizing the use of external support (such as concept map) and that b) increased study time allocation to the most relevant information (graphic aids vs. text only) during encoding might be a compensatory strategy through which text memory is maintained in later adulthood (Stine-Morrow et al., 2008).

- The finding that CM was no more effective than the control graphic suggests that the oft-observed advantage of CM over text alone derives from helping readers identify key concepts rather than how the concepts are organized in the text. Further analysis of the eye-tracking data in relation to recall will explore whether subsets of participants especially benefit from the structured aid, and why the CM appeared to provide less efficient support (that is, participants viewed the CM longer, but with no additional benefit for recall).

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Email: gao5@illinois.edu

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