



The Effects of Domain General and Health Knowledge in Processing General and Health Texts among Older Adults with Hypertension

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Abstract

Health knowledge supports understanding of health information, but little is known about the processing mechanisms underlying this effect. We examined attention allocation to reading health and general texts among older adults with hypertension who varied in verbal ability (general knowledge) and health knowledge. More knowledgeable readers allocated less time to word-level processing and more to conceptual integration. Domain knowledge further engendered earlier conceptual integration in the health texts; more knowledgeable readers spent more time integrating concepts earlier in the sentence and less time at the end of the sentence. This suggests that knowledge gave readers a head start in building a representation of the ideas conveyed by the sentence. Furthermore, this earlier wrap-up strategy was associated with better recall performance.

Introduction

•Cognitive development has distinctive trajectories across the life span (Baltes, 1997), with processing capacity (e.g., working memory) declining but knowledge sustained with aging (Beier & Ackerman, 2005).

•The interplay between **processing capacity constraints and knowledge benefits** shapes comprehension, especially among older adults (e.g., Stine-Morrow, Miller & Herzog, 2006).

•Comprehension processes such as integrating concepts into a textbase representation are vulnerable to aging due to the heavy demands on working memory (Johnson, 2003). On the other hand, comprehension processes may be more efficient (less dependent on processing capacity) when supported by knowledge.

•According to the **self-regulated language processing (SRLP)** model (Stine-Morrow, Miller & Hertzog, 2006), readers allocate attention to different levels of text in order to derive representations that are “good enough” to satisfy comprehension goals.

•The reading time (i.e., resources) allocated to constructing representations can be measured by the time individuals spend on different features representing **word-level and textbase processing** (Lorch & Myers, 1990).

•We adopted the SRLP model to examine **the effects of general and domain (health) knowledge** on the allocation of cognitive resources to understanding **general and health texts** among older hypertensive patients, whose health knowledge may facilitate comprehension of health texts.

•Knowledge-driven conceptual integration processes especially occur at the end of **clauses, (intra-sentence boundaries)** (Miller, et al., 2004).

Methods

Participants

118 participants (Mean Age=70; 60-88 yrs). 53 % had high school or less level of education. Most participants (N=112) were diagnosed with hypertension. Participants were administered a battery of tests measuring **processing capacity (speed and working memory), general knowledge (verbal) and health knowledge (hypertension)**.

Materials

48 sentences were used. Half were about hypertension and other cardiovascular disease topics and the other half about general topics (the two sets did not differ in number of syllables, propositions, or new concepts).

General Texts: *A leopard is strong and agile enough to be able to tackle prey weighing twice its own weight.*
Health Texts: *Hypertension is the “silent killer” because it usually has no symptoms until it causes damage to the body.*

Procedure

Sentences were presented one word at a time on a computer following the moving window paradigm (Just et al., 1982), with presentation self-paced.

Results

Individual Regression Analyses

Word-level variables: number of syllables and log word frequency (Balota et al., 2007).

Textbase processing variables: This involved assigning dummy codes (0/1) to the presence of **intrasentence syntactic and sentence boundaries** weighted by the number of new concepts introduced up to that point (Stine-Morrow, Milinder, Pullara & Herman, 2001). Intrasentence boundary integration (earlier wrap-up) and sentence boundary integration (later wrap-up).

Pearson correlations between resource allocation parameters across the two text domains were consistently strongly positive, which implied that participants **used the same strategies to read general and health texts** (association between parameters in two texts: word frequency: $r=.72$; syllable: $r=.56$; intrasentence integration: $r=.61$; sentence boundary integration: $r=.94$; all p 's<.001).

Mixed-effects Modeling

Mixed-effects (multilevel) models were conducted (Bates, 2005; Bates & Sarkar, 2007) to estimate simultaneously both fixed effects and random effects of subjects and items within this cross-level design.

Estimated parameters (with standard error of estimates) of mixed-effects modeling in general and health texts.

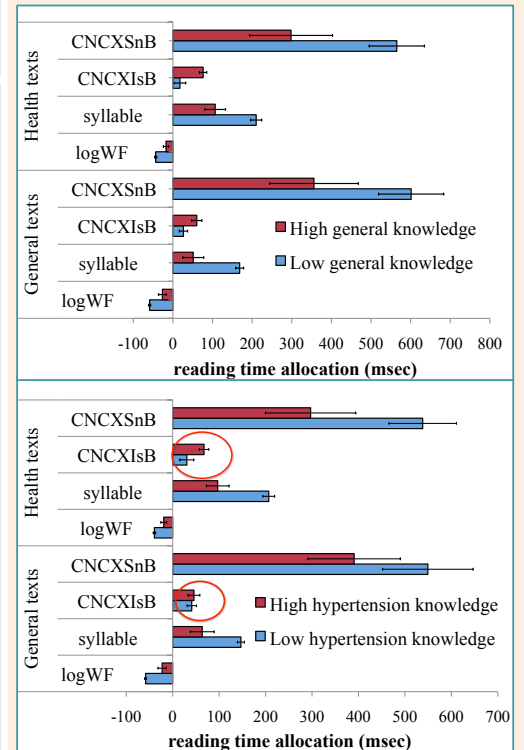
Fixed effect	General Texts		Health Texts	
	B	t	B	t
Intercept	1546.78(1022.97)	1.51	2728.26(844.85)	3.23*
Item Predictors				
LogWF	-61.45 (23.82)	-2.58*	-133.89 (26.85)	-4.24*
Syllable	167.24 (115.74)	1.45	175.87 (100.8)	1.75
CNCXIsB	107.2 (64.19)	1.67	-99.24(643.64)	-1.56
CNCXSnB	605.29 (83.39)	7.26*	1384.72 (78.4)	17.66*
Subject Predictors				
Age	-1.22 (10.3)	-0.12	-6.09 (7.78)	-0.78
Processing capacity	-134.33 (34.57)	-3.89*	-116.65 (26.13)	-4.47*
General knowledge	-359.23 (100.66)	-3.57*	-132.02 (85.87)	-1.54
Health knowledge	-3.88 (27.75)	-0.14	-39.52 (23.94)	-1.65
Cross Level Interactions				
General knowledgeXLogWF	24.76 (2.83)	8.76*	12.44 (3.17)	3.93*
General knowledgeXSyllable	-66.97 (13.73)	-4.88*	-85.42 (11.89)	-7.18*
General knowledgeXCNCIsB	31.78 (7.65)	4.16*	21.92 (7.51)	2.92*
General knowledgeXCNCXSnB	-161.3 (9.92)	-16.27*	-127.13 (9.25)	-13.74*
Health knowledgeXLogWF	0.94 (0.82)	1.15	2.81 (0.92)	3.06*
Health knowledgeXSyllable	-0.39 (3.98)	-0.1	0.44 (3.45)	0.13
Health knowledgeXCNCIsB	-3.08 (2.22)	-1.39	4.64 (2.18)	2.13*
Health knowledgeXCNCXSnB	-3.64 (2.87)	-1.27	-32.68 (2.68)	-12.19**
BIC	905532		889036	
-2 Log Likelihood	905314		888820	

Note: LogWF=word frequency; syllable=number of syllables; CNCXIsB= intrasentence integration; CNCXSnB= sentence boundary integration. * $p < .05$

Interaction between Texts and Knowledge Domains

To visualize the significant interaction effects, we did a median split on the general knowledge and health knowledge scores, and then show the patterns of four allocation parameters across two sets of texts below.

- 1) People with more knowledge (general or health) **spent less time doing word level processing**. → Knowledge **facilitated** the word level processing **across text domains**.
- 2) People with more general knowledge spent more time **wrapping up earlier** in the sentence **across text domains**.
- 3) People with more health knowledge spent more time **wrapping up earlier** in health texts.



Patterns of resource allocation to general and health texts for older adults: LogWF=word frequency; syllable=number of syllables; CNCXIsB= intrasentence integration; CNCXSnB= sentence boundary integration.

Main Findings

Overall effects of knowledge

More knowledgeable readers: more efficient word-level processing and earlier conceptual integration (across domains) (Miller et al., 2004).

The effects of health knowledge on health texts

More knowledgeable readers: earlier conceptual integration in the health text but not in the general texts.

Conclusions

Pay-now vs. pay-later effects

Knowledge scaffolds conceptual integration, allowing readers to invest more resources in earlier wrap-up, which facilitates later processing (less effort in the later wrap-up). **Pay-now is a more efficient (less time) and more effective (better recall) strategy.**