

CHAPTER 4

Manuals for the Elderly: Text Characteristics That Help or Hinder Older Users

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Manuals for consumer electronics devices are often criticized for being difficult and inaccessible for many users, especially elderly people. This is an important target group, however, because within the next few decades, almost half of the population in the Western world will be older than 50. More and more elderly people will use consumer electronics devices. Lippincott (2004) argues that multidisciplinary research projects are needed in order to investigate the behavioral and cognitive differences between age groups interacting with technical communication.

In the last few years, several gerontological studies have shown that major advances have been made in adapting technology to elderly people. Hartley (1994) listed various rules of thumb for designing instructional text for elderly people. Both T. D. Freudenthal (1998) and A. Freudenthal (1999) studied elderly people's interactive behavior with complex devices in order to identify characteristics of the devices that cause problems, along with characteristics of elderly people's behavior that might explain their problems. Wright (2000) investigated the use of instructions by elderly readers.

The studies discussed in this chapter aim at contributing to the identification of characteristics of instructions that cause elderly users' problems with electronic devices. In a first phase, an exploratory study resulted in three candidate variables that may cause problems: temporal iconicity, the signaling of steps, and the absence of goal and consequence information. In a second phase, the effect of manipulating these three variables was investigated in three experiments.

TEMPORAL ICONICITY

Research on the effects of aging on the reading process has shown that stories told in a nonchronological order are harder to comprehend for older people than for younger (Smith, Rebok, Smith, Hall, & Alvin, 1983). When people operate devices, it is important that actions be performed in the correct order. Instructions should help the user to conceive the correct order of procedural steps. It seems obvious that instructions should therefore mention the actions in the order that they have to be executed.

We refer to this similarity between textual and actual procedure as "temporal iconicity." According to Enkvist (1981), "Iconicism occurs whenever the linear relations in a text stand for temporal [. . .] relations between the referents in the world described by that text" (p. 99). We expect that especially the elderly benefit from temporal iconicity in instructions.

SIGNALING STEPS

In many advisory guides for document design, the importance of segmenting and signaling procedural steps is stressed. In general text comprehension, signaling words (such as *therefore*, *but*, *because*, *first of all*, *secondly*, *likewise*, *nonetheless*, and so forth) help the reader to understand the text's structure and to build a correct and coherent mental representation (Lorch & Lorch, 1996).

Segmentation in instructions is important because it enables users to switch more easily between manual and device (Steehouder & Karreman, 2000). People read a step from the procedure, execute it on the device, and go back to the text to read the next step.

Some research has been done on older people's memory for performed tasks. Kausler and Hakami (1983) had older and younger people perform a series of tasks, after which they were given a recall task. The older participants recalled fewer tasks than the younger. Some researchers explicitly recommend giving instructions in formatted lists to facilitate this recall process (Wright, 2000). In our experiments, we expected that clear signaling of the instructions is beneficial, especially for older users.

GOAL AND CONSEQUENCE INFORMATION

Manuals can never be fully explicit. Users must always infer information from their background knowledge and from the task context. Research on the effects of aging on the process of inferential reasoning has shown that elderly people are less capable of making inferences than younger people (Cohen, 1981). If manuals only explicitly mention the action to be performed and not the context in which this action will take place, older users especially may have problems with the required inferences.

In order to decide which information is relevant, an inventory of information types in instructions is needed. Inspired by Farkas (1999), we defined four basic

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types of procedural information. Farkas describes the process of operating a device as bringing it from an original status into a desired or goal status. *Goal information* describes the desired status and *starting point information* describes the original status. *Action information* describes the actions that lead to the goal status. Finally, *consequence information* describes what can be observed on the device when an action is performed, in order to be able to check whether an action was performed correctly. Goal and consequence information were the objects of our investigation.

In sum, we investigated experimentally the effect of three types of variables in manuals: the iconic or noniconic order of actions, the signaling of steps, and the presence of goal and consequence information. In the experiments, people from two age groups volunteered: older participants, aged between 60 and 70 years, and younger participants, aged between 20 and 30 years. In all experiments, we balanced the number of male and female participants and the education levels between the age groups. We investigated the variables with the help of statistical tests. In this chapter, we discuss only the main effects and interactions that were found to be statistically significant.

EXPERIMENT I: ICONICITY AND THE SIGNALING OF STEPS

The variables iconicity and the signaling of steps were investigated in an experiment with a fictitious device: a medical laser. In this experiment, 30 older and 30 younger participants were given iconic and noniconic procedures as well as instructions with different types of signaling (see Table 1 for examples of each condition). There were two text manipulations.

First of all, we constructed two iconicity conditions analogously to the materials from investigations on the processing of event order in discourse. Clark and Clark started this work in 1968, giving people complex sentences containing the connectives *before* or *after*, such as "He tooted the horn before he swiped the cabbages" and "He swiped the cabbages after he tooted the horn" (Clark & Clark, 1968). In the other text manipulation, the action steps were either not signaled, signaled visually, or signaled by verbal means (connectives).

After reading the instructions, the participants viewed a correct or incorrect simulation of the procedure on a TV screen, which they had to judge for correctness. Reading times, time that was needed to judge the simulation (reaction time), and error rates were measured. In analyses of variance for repeated measures, main effects for the factor "age group" were found. The task appeared to be harder for the older group on three dimensions. Compared with the younger, the elderly needed more time to read the procedures and to judge the simulations, and they made more incorrect judgments. The reaction times are given in Table 2. Results on the error rates and the reading times also showed main effects only for the factor "age group."

In the analyses, significant differences were found for the type of simulation. Unlike the younger group, the elderly needed more time and were less accurate in judging incorrect as compared with correct simulations. Unexpectedly, however, text differences did not affect task performance. We found no main effects and no

Table 1. Conditions in Experiment I

	Example
Iconic	Shift the power switch to <1>. Shift the limiter to <low> before you press <green> to start the treatment.
Noniconic	Shift the power switch to <1>. Press <green> to start the treatment after you have shifted the limiter to <low>.
No signals	Shift the power switch to <1>. Shift the limiter to <low>. Press <green> to start the treatment.
Visual signals	1. Shift the power switch to <1>. 2. Shift the limiter to <low>. 3. Press <green> to start the treatment.
Verbal signals	First shift the power switch to <1>. Then shift the limiter to <low>. Finally press <green> to start the treatment.

Table 2. Mean Reaction Times (in Seconds) per Simulation Type (Correct vs. Incorrect), Text Condition, and Age Group

Age group	Iconicity			Signaling of steps			
	Iconic	Noniconic	Mean	Neutral	Visual	Verbal	Mean
Correct simulations							
Old	1.821	1.629	1.669	1.750	1.786	1.860	1.751
Young	1.163	1.131	1.140	1.207	1.337	1.312	1.288
Mean	1.462	1.357		1.459	1.545	1.566	
Incorrect simulations							
Old	3.590	4.058	4.549	3.914	4.728	3.919	4.281
Young	2.663	2.787	2.744	3.143	3.056	2.469	2.885
Mean	3.018	3.274		3.382	3.573	2.918	

interactions. It is hard to interpret this outcome, especially in the case of iconicity, which turned out to be effective in research with other text genres. Perhaps the manipulations were too limited to play a noticeable role in the relatively broad judging task in this experiment.

Regarding the signaling of steps, it should be noted that switching behavior between text and device, which is necessary in natural situations where instructions first have to be read and then physically carried out, was ruled out in our experiment.

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Participants were asked to judge only simulations, not to perform real actions with an actual device. This might explain why we found no effect for signaling of steps. Future experiments could be carried out to find out what happens when readers of instructions switch between text and device.

EXPERIMENT II: ICONICITY

To further explore the effects of iconicity on older and younger readers of instructions, a follow-up experiment was conducted in which participants had to execute specific tasks. A simple and straightforward task on a computer screen was created. A total of 18 younger and 15 older participants were presented with iconic and noniconic instructions (see Figure 1), and were asked to execute these instructions by pressing two keys on the keyboard. Reading times (defined as the time between the appearance of the stimulus on screen and the participant's first push on a key) were measured.

By varying the temporal connective and the position of the main and subordinate clause, we created four types of sentences, as can be seen in Table 3. For each sentence in Table 3, a second one was also used, in which the color words were switched. Each participant was exposed to 62 sentences (32 experimental sentences

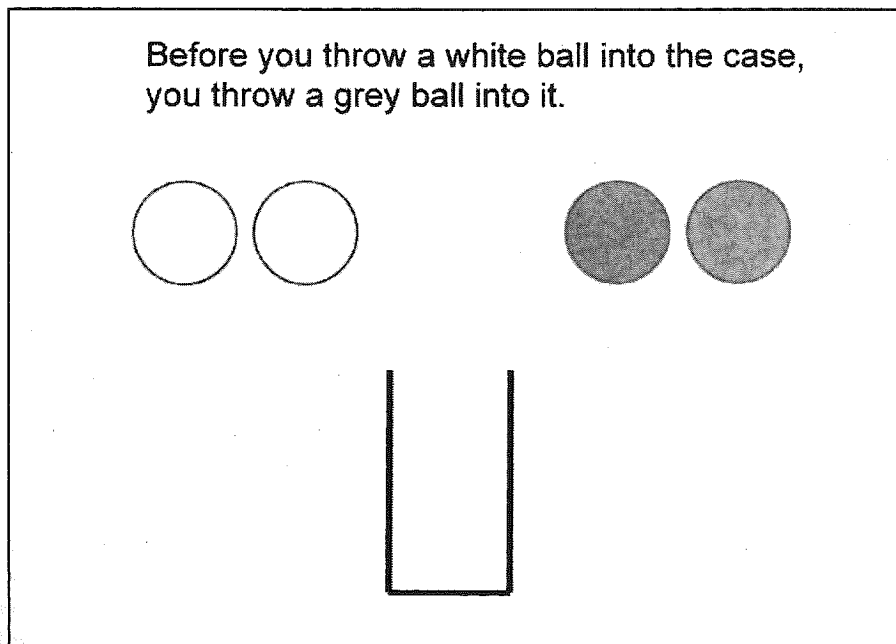


Figure 1. Example of the task screen, with an example instruction in Experiment II.

Table 3. Conditions in Experiment II. (The nature of the first clause [main vs. subordinate clause] and the connective [before, after] are given in the "condition" column.)

Condition	Sentence
Iconic 1 (main clause first, before)	Throw a white ball into the case, before you throw a grey ball into it
Iconic 2 (subclause first, after)	After you have thrown a white ball into the case, you throw a grey ball into it
Noniconic 1 (main clause first, after)	Throw a grey ball into the case, after you have thrown a white ball into it
Noniconic 2 (subclause first, before)	Before you throw a grey ball into the case, you throw a white ball into it

and 30 fillers with two identical color words). The results of this experiment are presented in Table 4.

We executed analyses of variance for repeated measures. As expected, the older group needed far more time than the younger. Apart from that outcome, the results were rather surprising.

We found a main effect of the factor "clause position." When the subordinate clause preceded the main clause, the reading times were shorter. In other experiments with comparable (though not instructive) stimuli, the sentences with the main clause in first position were processed and remembered better than sentences starting with the subordinate clause (Clark & Clark, 1968; Smith & McMahon, 1970). In this experiment, the subclause contains more crucial information on the task than the main clause, that is, information on the order of the two tasks. This is a likely reason for the shorter reading time of this version in this experiment.

Another surprising result was the main effect of the factor iconicity that was found: in both age groups noniconic sentences had shorter reading times than iconic sentences. This result can also be explained by the typical task situation in the experiment. The instructive sentence and the task (i.e., the balls and the case) were displayed on the same screen, so readers did not have to memorize the text or switch between reading and performing. Apparently, task execution was faster when participants could start executing the action they had read most recently.

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Connective
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Clause position
Main-Subordinate
Subordinate-Main

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Table 4. Overall Mean Reading Times (in Seconds) and Means per Age Group for Each of the Two Variants of the Factors Iconicity, Connective, and Clause Position

	Age group		Mean
	Younger	Older	
Iconicity			
Iconic	2.62	3.53	3.08
Noniconic	2.48	3.38	2.93
Connective			
Before	2.54	3.44	2.99
After	2.57	3.47	3.02
Clause position			
Main-Sub	2.68	3.68	3.18
Sub-Main	2.42	3.23	2.83

Table 5. Overall Mean Reading Times (in Seconds) and Means per Age Group for the Two Variants of the Factor Color Word Order

Age group	Color word order	
	White - Grey	Grey - White
Younger	2.47	2.63
Older	3.24	3.69
Mean	2.85	3.16

Another result concerned the order of the color words in the sentence. Variations in the order showed an interaction with the age group. Table 5 shows that sentences with a "white-grey" order were read faster than sentences with a "grey-white" order, especially by the older age group. An explanation can be found in the order of the balls on the screen, which was invariably white-grey, as can be seen in Figure 1.

The shorter reading times for white-grey sentences may be the result of what we may call "perceptual" iconicity, that is, the correspondence between the order of the color words in the sentence and the position of the balls on the screen. A future experiment in which the position of the colored balls is varied could shed more light on this hypothesis.

EXPERIMENT III: THE NEED FOR GOAL AND CONSEQUENCE INFORMATION

The third experiment investigated the effects of goal information and consequence information. We designed instructions in which the presence of the two information types was varied. A total of 39 younger and 35 older participants executed tasks on a central heating thermostat. They were given one of three versions of a manual.

Throughout the manual, action information was always specified. Apart from that, in one version of the manual both goal and consequence information were given. In the other two versions, one of the two information types was systematically left out. Examples of the descriptions of an action in the three versions can be seen in Table 6.

Participants worked aloud, and video recordings of their behavior were made. The elements in the manual that were read, the errors that were made, and the time that was needed to perform each action were analyzed. Performance times and the number of correct actions are given in Table 7.

In analyses of variance, main effects for each age group were found. The older group needed more time to perform actions and they made more errors than the younger group. In the performance times, we found an interaction of text version and age group. The elderly needed more time for the version without consequence information than for the other versions, whereas in the younger group no difference between the versions were found.

Apparently, the elderly benefit from information enabling them to check if an action is finished and whether it has been performed correctly. Consequence information may bring a sense of security to the interaction with a device. It is easy to imagine that this is more comfortable for elderly users, because it enables them to

Table 6. Conditions in Experiment III

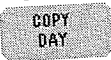
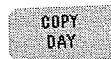
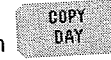
Conditions	Example of an action description
+ goal information	Activate the copying function:
+ consequence information	Press the button  once. The word "Copy" appears in the display. The copying function is now active.
- goal information	Press the button  once. The word "Copy" appears in the display. The copying function is now active.
- consequence information	Activate the copying function: Press the button  once.

Table 7. Mean Performance Times (in Seconds) and Mean Number of Correct Actions per Age Group in the Three Conditions (+ goal/consequence, - consequence, - goal)

	+ goal information + consequence information	- consequence information	- goal information
Performance time			
Younger	14.58	9.55	8.88
Older	15.54	20.51	12.81
Correct actions			
Younger	26.5	26.8	26.3
Older	20.2	22.1	20.2

keep track of the procedures. Another explanation is that they may be less able than the younger participants to infer the consequence from the information in the manual, their own knowledge, and signals on the thermostat.

DISCUSSION

The goal of our research project was to identify and further investigate text characteristics that help or hinder older people's interaction with devices and manuals. The role of temporal iconicity, the signaling of steps, and the absence of goal information and consequence information was investigated. In the three experiments that we carried out, clear age effects were found. The elderly needed more time to read instructions and to execute the tasks, and with respect to performance quality, they performed worse than the younger age group. We finish this chapter with an attempt to translate the results into three cautious guidelines for manuals that meet the needs of an older audience.

Segmentation of instructions

The results of Experiment II suggest that temporal iconicity of instructions is not helpful. It appears to be more important for readers to perform an action immediately after reading about it; and in Experiment II this is only the case in the noniconic sentences. This result may be regarded as a plea for a clear segmentation of procedural steps: apparently readers want to perform the step they just read about as quickly as possible. Segmentation of instructions clarifies to the reader when to stop reading and start performing, and what text fragment to go to after performing, without erroneously repeating or skipping actions.

At first sight, this plea for segmentation may seem to contradict the results of Experiment I, which showed no effects for the signaling of steps. However, Experiment II measured text effects while people were actually performing tasks.

In Experiment I, people did not perform instructions. We think the segmenting of instructions will support readers who have to execute tasks. We expect that segmentation is especially helpful for readers who have to switch continuously between reading instructions and operating devices.

Put the Most Informative Part of the Instruction First

The reading times in Experiment II were influenced by the position of the two clauses, with an interaction with age group. We argued that this result was probably caused by the fact that the information about the order of the actions was present only in the subordinate clause. This result suggests the following principle: put the most informative part of the instruction first. The context influences which information is most informative. In Experiment II, the information that was most informative to the performance of the actions was the connective: it contained information about the order of the two actions. Document designers should adopt the perspective of the user in order to decide which information is most informative for the task at hand.

Consequence Information is Important

Experiment III yielded results that can easily be applied: it is important to describe the means to check whether an action has been performed (correctly). Apparently elderly users want to know "what will happen." Document designers should describe the results of an action and the feedback signals that can be perceived on the device.

REFERENCES

- Clark, H. H., & Clark, E. V. (1968). Semantic distinctions and memory for complex sentences. *Quarterly Journal of Experimental Psychology*, 20(2), 129-138.
- Cohen, G. (1981). Inferential reasoning in old age. *Cognition*, 9(1), 59-72.
- Enkvist, N. E. (1981). Experiential iconicism in text strategy. *Text*, 1(1), 97-111.
- Farkas, D. K. (1999). The logical and rhetorical construction of procedural discourse. *Technical Communication*, 46(1), 42-54.
- Freudenthal, A. (1999). *The design of home appliances for young and old consumers*. Delft, The Netherlands: Delft University of Technology.
- Freudenthal, T. D. (1998). *Learning to use interactive devices: Age differences in the reasoning process*. Eindhoven, The Netherlands: Eindhoven University of Technology.
- Hartley, J. (1994). Designing instructional text for older readers: A literature review. *British Journal of Educational Technology*, 25(3), 172-188.
- Kausler, D. H., & Hakami, M. K. (1983). Memory for activities: Adult age differences and intentionality. *Developmental Psychology*, 19, 889-894.
- Lippincott, G. (2004). Grey matters: Where are the technical communicators in research and design for aging audiences? *IEEE Transactions on Professional Communication*, 47(3), 157-170.

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- Lorch, R. F., & Lorch, E. P. (1996). Effects of organizational signals on free recall of expository text. *Journal of Educational Psychology*, 88, 38-48.
- Smith, H. K., & McMahon, L. E. (1970). Understanding of information in sentences: Some recent work at Bell Laboratories. In G. B. Flores d'Arcais and W. J. M. Levelt (Eds.), *Advances in psycholinguistics* (pp. 173-192). Amsterdam/Oxford: North-Holland Publishing Company.
- Smith, S. W., Rebok, G. W., Smith, W. R., Hall, S. E., & Alvin, M. (1983). Adult age differences in the use of story structure in delayed free recall. *Experimental Aging Research*, 9(3), 191-195.
- Steehouder, M., & Karreman, J. (2000). De verwerking van stapsgewijze instructies. *Tijdschrift voor Taalbeheersing*, 22, 218-237.
- Wright, P. (2000). Supportive documentation for older people. In C. Jansen, R. Punselie, & P. Westendorp (Eds.), *Interface design and document design* (pp. 31-43). Amsterdam: Editions Rodopi BV.