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MANUALS FOR THE ELDERLY: WHICH INFORMATION CANNOT BE MISSED?[1]

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ABSTRACT

Elderly people seem to encounter more problems than people from other age groups do, when using consumer-electronics products and their accompanying manuals. This may be due to the absence of some kinds of information. In this study effects of the absence of different information types in instructions on action performance were explored for different age groups. Younger (aged 20-30 y.) and elderly (aged 60-70 y.) participants installed a VCR with the help of the manual, while working aloud. The absence of goal-information, consequence-information and identification-information in the instructions proved to have a negative effect on task performance, especially for the elderly participants. When one of these information types was absent in the instructions the elderly performed more actions incorrectly than when the information was stated explicitly.

Many people who ever bought a consumer electronics device and tried to get it to work with the help of the instructions, ended up criticizing the manual. Many users can't make head or tail of manuals, but elderly people seem to encounter even more problems with instructions that accompany complex products.

Within the next few decades almost half of the population in the western world will be older than 50. As a consequence, consumer electronics devices will be used more and more by elderly people. This prospect urges interface designers and document designers to think about improvements in the design of the devices and the accompanying manuals, in order to make sure that they are more usable for both elderly and younger people. In the last few years in several gerontechnological studies important steps have been made towards a better balance between technology and elderly people. Hartley (1) for example has given an inventory of rules of thumb for designing instructional text for elderly people. Both T.D. Freudenthal (2) and A. Freudenthal (3) studied elderly people's behavior in interaction with complex devices in order to identify characteristics of the device that cause problems and characteristics of elderly people's behavior that might explain their problems. Wright (4) investigated the use of instructions by elderly readers.

This article attempts to contribute to the identification of sources of elderly users' problems with electronic devices. The experiment described in this article is part of a research project that is intended to lead to guidelines and advice for designing manuals that fit the needs of elderly people. The first step in the project is to determine text features that appear to help or hinder

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the elderly. Then effects of the text features will be investigated experimentally. Based on the results, guidelines for writing manuals for an elderly audience will be formulated. Finally, the guidelines will be tested and, if necessary, will be adapted. The experiment described here is the realization of the first step in the research project.

ELDERLY READERS

Several gerontological studies have indicated differences between elderly people and people from other age groups that might be relevant for processing instructions (see for extensive literature surveys (5) and (4)). Elderly readers often perform worse than younger readers in the reading process. Many studies in non-instructive texts indicate that it is harder for the elderly to make inferences in text than it is for younger age groups (6), (7), (8), (9), (10), (11). Elderly people perform equally well as younger people when they have to answer verbatim questions about a text, after having read it or having listened to it. The elderly perform worse than younger people when questions are not verbatim or when information has to be inferred from the text.

When looking at a number of manuals it is often seen that information is not stated explicitly. An example from a procedure to use the readout of a cell phone as a scratch pad[2]:

> **Scratch-pad dialing**
> This feature permits you to enter a number to be redialed (or store a number in memory) while engaged in a conversation.
>
> **Scratch-pad dialing without keying tones**
> This feature permits you to activate scratch-pad memory without annoying key tones over the circuit.
>
> 1. Press FNC, 4. **Tone** will appear on the readout. The Microphone circuit will remain active, but the tones will not be heard.
> 2. Enter the phone number.
>
> If necessary, press FNC, R/ST, then enter the memory address.
>
> 3. To active the tones, press FNC, 4 again.

Some of the information that could have been given, is not stated in the above. For example the actual working of the scratch-pad feature is not explained at all under the first heading (it can be deduced from the information under the second heading). Furthermore it is unclear what the goal is of the procedure 'press FNC, R/ST, then enter the memory address'. This procedure can be used to store the number in memory, but the storage feature is explained in a different chapter of the manual.

While working with the cell phone users might deduce the information that is not given from what they see on the readout. Furthermore users might

[2] Example from the on-line manual of the Audiovox MVX850 Cell Phone, provided by www.livemanuals.com. References to buttons are printed green in the original on-line manual; they are underlined in this adaptation.

have some experience with similar devices, which also helps them work their way through the procedure. On the other hand, it is also possible that users don't understand the storage procedure. After ending the conversation, they might loose the telephone number they just entered.
From this example it can be deduced that the discrepancy between the amount of information that *could* be given and the information that actually *is* given can be quite large. This raises the question when the amount of information is sufficient. Minimalist theories like Carroll's (12) encourage the designer to deliberately leave a lot of information out of the manual. But because of the heavy load that processing instructions puts on cognitive resources, it might be expected that the implicitness of information complicates the processing of instructions for elderly people, who suffer from decreased processing capacity anyhow.
Another observation is that the nature the information that is not stated explicitly varies over manuals. This raises the question which types of information are more important for users than others and whether there are differences between age groups in this respect. To answer these question an experiment was conducted. As a preparation an inventory of different types of information in instructions was made.

BASIC TYPES OF INFORMATION

An elaborate description of human interaction with devices is given by Farkas, in his analysis of the logical structure of procedural discourse (13). He describes operating a device as a part of goal oriented human behavior. It can be regarded as *changing the current state* of a device into another state. The different states of the device can be described as a *prerequisite state* and a *desired state.* The user changes the prerequisite state by performing actions with the device. When the desired state is to be achieved by a *series* of actions, i.e. a procedure, each action results in an *interim state* that differs both from the prerequisite state and the desired state. Achieving each of these states is a *goal* in itself. Below we will give a classification of instructional information types that follow from Farkas' description of users operating a device. The terminology for this classification is closely related to Steehouder and Jansen's (14).

Users who know how to operate a device have an adequate mental representation of the goals (or *states*) to be achieved and the actions necessary to achieve the goals in a serial-hierarchical structure (15). Based on this mental representation the device is operated. Someone who does not know how to operate a device has to build such a mental representation, for example on the basis of the manual. The most basic types of information in a procedure are *goal information* and *action information*. But these are not the only types of information that play a part in the operation of a device and the mental representation of the operations.

To decide whether an action is performed correctly, users also need to know what should be the exact consequence of that action, so that the user can compare the description of the consequence to the actual consequence of the performed action. This kind of information is related to Farkas' *system actions*. We will refer to it as *consequence information*. To

decide *when* an action should be performed in the first place, the user needs to know the required circumstances that apply before action performance (*prerequisite state*): *starting point information*. Of course, starting point information often coincides with the consequence information of a previous action.

OTHER INFORMATION TYPES

The four types of information mentioned so far (goal, action, consequence and starting point) are the basic information elements in a procedure. They support the actual actions that a user needs to perform on a device. Depending on the design of (the interface) of a device, the type of task or the type of users, additional information might be needed or desired. Table 1 is an inventory of other possible types of information, based on the categorization by Steehouder and Jansen (14):

Table 1. Other possible information types in an instruction module.

Information type	Example
Illustration The action is clarified by visual information on action performance or on the location of parts of the device	In a manual for a sewing machine: A picture of thacking the thread into the machine
Example The action is clarified by the description of a detailed execution of a procedure with random data	In a manual for a CD-player: A description of all the actions that need to be performed to program tracks 1, 2 and 5 of a CD
Identification The action is clarified by information which identifies the entities which are involved. Location, color, shape or other characteristics of the entity are described.	In a manual for a tuner: 'Turn the tuner on by pressing *the green 'power' button on the remote control*'
Advice The user is given information about the *easiest* or *most comfortable* way to perform an action	In a manual for a photo camera: A description of the best way to hold the camera
Reference The user is referred to other parts of the manual, where e.g. a (sub)procedure is described more comprehensively.	In a recipe for making a fish stew: 'In the *techniques* chapter you can see how to fillet the bass.'
Problems The user is presented with problems that can occur during performance of the current action, possible causes and solutions. In Farkas' terminology this information is about *unwanted states* and *external states*.	'If your modem does not respond, make sure that you have selected the correct speed in the modem control panel.'

The information types described in table 1 are closely related to the actual operation of a device. This research concentrates only on these information types. Of course other types of information can be found in manuals as well. Ummelen (16) for instance showed that most manuals contain a lot of *declarative* information, for example explanations on how a system works, or how it can be applied in everyday life. Furthermore manuals often contain warnings, technical specifications and indexes. All these information types however fall outside the scope of this article.

Furthermore, the information elements can operate on different discourse levels, i.e. the local level of each separate procedure step, the more global level of a whole procedure or function, or the highest level of the whole manual (e.g. in the case of advance organizing information or general warnings). For current purpose, we take the local perspective and start from the observation that each step in a procedure, may be expressed in terms of the four basic types of information (goal, action, starting point and consequence) as well as in terms of additional information types. The combination of all information elements that apply to one step in a procedure is referred to as an *instruction module* (15).

This inventory does not suggest that a manual is only adequate and complete if each procedure step contains all these information types. That would result in manuals that are far too extensive. While designing a manual one has to take into account what the intended users already know. Dependent on the knowledge of the user it can be decided how extensive or how specialized the information in the manual should be.

RESEARCH QUESTIONS

If - according to previous research - elderly readers have (more) problems with implicit information and inferring information, one may ask what happens if elderly users have to work with instructive texts, which – according to the observations given above – can hardly ever be fully explicit. What is the effect of the absence of specific information types in manuals on the user's success? What differences in efficiency can be observed for different types of information? Is there a decrease in performance success as the number of 'absent information types' increases? Do elderly users have more problems with the absence of information types than their younger colleagues?

To explore these questions we carried out a performance experiment. Participants from two age groups performed an installation task with a VCR with the help of the manual, while thinking aloud. In advance, the manual was analyzed for the presence of different types of information. In the experiment, the interaction was investigated between the performance success of the users and the completeness of the instruction modules.

METHOD

Participants. Thirteen elderly people aged between 60 and 70 years (mean age 64) and thirteen younger people aged between 20 and 30 years (mean

age 23) participated in the experiment. There were 3 females and 10 males in the younger age group. There were 6 females and 7 males in the older age group.

Materials. The manual from the DAEWOO DV-F932B VCR was used in the experiment. This manual was chosen because it contained both modules that were explicit and modules in which different types of information were left implicit.

Experimental task. Participants worked with the DAEWOO DV-F932B VCR, a PHILIPS color television set and a copy of the original VCR manual, in which only those pages were included that were needed for the experimental task. Task performance was registered with a microphone and 2 video cameras. The task consisted of four steps:

1. Connecting the VCR to the television, the antenna and to electricity.
2. Putting the remote control into use.
3. Installing the VCR (choosing a country and a language, make the VCR search for broadcasting stations from the antenna).
4. Sorting certain broadcasting stations into the first five channels on the VCR.

Procedure. Participants entered the experiment individually. To become familiarized with the working aloud method, participants performed a small practice task. After that, participants were given 40 minutes to perform the installation task. Data registration was turned off after 40 minutes, or earlier when the participant finished the tasks in shorter time, or when the participant indicated not to be able to continue the task.

PRESENCE OF INFORMATION IN THE MANUAL

To identify the completeness of the manual, we constructed a *criterion manual* on the basis of the following three step procedure. In a first step, we constructed a structure of actions on the basis of the tasks that participants had to perform in the experiment and of the working of the VCR used in the experiment. This resulted in 57 low level action components (i.e. the level of actions like 'press the OK button', an action which was not further divided into subordinate 'actions' like 'move finger to OK button', 'execute pressure on the button' etc.) In a second step, for each action component a complete instruction module was formulated, consisting of all basic information types plus relevant additional elements taken from the list in Table 1. In a third step, we deleted all elements which could safely be considered part of the normal knowledge base of both subject classes. Therefore a user profile of a regular user was defined; a user with little specific foreknowledge on the installation task, but with knowledge on basic actions such as 'plug in', 'press' etc. The user profile contained 'basic' information on electronic devices in general, on VCRs, on television sets and on remote controls (for example the user 'knows' that electronic devices run on electric current, that VCRs are used to play videotapes an to programme recordings, that the programmes on a TV set are supported through an antenna or cable and that a remote control runs on batteries). That way we reduced the criterion manual to more manageable dimensions.

In a fourth step, the actual manual that was used in the experiment was compared to the criterion manual. For each information element in the criterion manual it was determined whether it was stated explicitly in the actual manual. If it was not stated explicitly, it was considered to be absent. For 55 instruction modules from the criterion manual at least one information element was stated explicitly in the actual manual.

RESULTS

Protocols and scores. For each participant the audio-visual registrations were transcribed into a protocol that described the participant's utterances and actions and the parts in the manual that were read. Based on the protocols, for each information element in the manual it was determined whether a participant had read it or not. For each action in the criterion manual it was determined whether the participant had performed it and whether performance was correct.

Analyses were performed to investigate whether there were differences between age groups with respect to the following questions.

- To which extent do participants read the manual?
- To which extent are actions performed (correctly)?
- What is the effect of reading information in the manual on task performance?
- What is the effect of the absence of a certain information type on task performance? (This question was only answered for actions that participants had read information about.)
- What is the effect of the absence of *more than one* information type on task performance?

General behavior of age groups

First, we tested whether age groups used the manual equally extensive. Therefore, we computed for each participant the percentage of read and unread elements. Differences between age groups were tested in an analysis of variance. Table 2 shows that there was no statistically significant difference between age groups in the proportion of read information-elements ($F < 1$).

Table 2. Mean percentages of read and unread information-elements, per age group.

	Read	Unread
Younger	27%	73%
Older	25%	75%

Next, we tested whether there are differences between age groups for the number of performed actions and the extent to which actions are performed correctly. Therefore, for each participant, we computed the percentage of correctly performed actions, incorrectly performed actions and non-performed actions (100% represents all the actions in the criterion manual). Differences between age groups were tested in an analysis of variance.

Table 3 shows differences in task performance between age groups. Elderly participants performed fewer actions than younger participants did ($F = 39.23$, $p < .01$). The elderly participants performed fewer actions during the 40 minutes they were given, or they got stuck earlier. Moreover, younger participants performed more actions correctly than elderly participants did ($F = 16.09$, $p < .05$).

Table 3. Percentages correctly performed, incorrectly performed and non-performed actions per age group.

	Performed		Non-performed
	Correctly	Incorrectly	
Younger	76%	13%	11%
Older	39%	15%	46%

Third, we tested the effect of reading information on task performance. Therefore, we computed for each participant the proportion correctly performed actions of all actions that the participant had read information about. Table 4 shows no main effect for reading ($F = 3.71$, $p = .067$). Whether information was read or not read the proportion of actions performed correctly was equally large. There was no interaction for age groups.

Table 4. Mean proportions per age group of correctly performed actions when information was read and when information was not read.

Age group	Information was read	Information was not read
Young	.734	.826
Old	.465	.529
Mean	.594	.677

Effects for the absence of a single information type

Does the absence of specific information types decrease task performance? In order to answer this question, we first had to analyze how often each information type was absent in the actual manual. Information types that are absent only a few times in the manual, do not result in enough data for an analysis of variance. If an information type was considered to be needed in an instruction module and it is specified in the manual, the module is considered as a module in which the information type is 'not absent'. An information type is also considered to be 'not absent' for instruction modules in which it was *not* considered to be needed.

We decided to restrict the analysis to the information types that were *absent* in at least 30 % of the instruction modules and, at the same time, were *not absent* in another 30% of the instruction modules (cf. if an information type was absent in 75% of the instruction modules and not absent in 25% of the instruction modules, it was not analyzed). Furthermore, we restricted ourselves to the basic information types *action* information, *goal* information, *consequence* information, and one important additional element which is known to be essential in instructions, i.e. identification information (17). Multivariate analyses of variance were performed with proportions correctly performed actions (see table 5).

Table 5. Mean proportions 'correctly performed' actions when an information type was absent and when an information type was not absent, for both age groups (only for actions that information was read about).
+ = Information type is not absent (in N information modules).
- = Information type is absent (in N information modules).

Age group (n)	+ Action (22)	- Action (35)
Young (12)	.710	.809
Old (13)	.431	.538
Mean (25)	.565	.668
	+ Goal (42)	- Goal (15)
Young (12)	.735	.730
Old (13)	.637	.338
Mean (25)	.684	.526
	+ Identification (20)	- Identification (37)
Young (12)	.767	.705
Old (11)	.526	.281
Mean (23)	.642	.502
	+ Consequence (16)	- Consequence (41)
Young (12)	.749	.688
Old (11)	.485	.297
Mean (23)	.612	.501

Action information. There was a main effect found for the absence of action information ($F = 5.94$, $p = .023$): when action information was absent, more actions were performed correctly. There was no interaction found for age groups ($F < 1$). The results for the absence of action information are contrary to expectations. We will discuss them in the 'discussion' section.
Goal information. There was a main effect found for the absence of goal information ($F = 8.12$, $p < .01$). The main effect was caused almost completely by the older age group: there was an interaction found for age groups ($F = 7.62$, $p = .011$). When goal information was missing, especially elderly participants performed fewer actions correctly than when goal information was not missing.
Identification information. There was a main effect for the absence of identification information ($F = 12.41$, $p < .01$). Here again, there was an interaction found for age groups ($F = 4.81$, $p = .04$). Especially elderly participants performed fewer actions correctly when identification information was missing than when it was not missing.
Consequence information. There was a main effect found for the absence of consequence information ($F = 5.38$, $p = .030$): when consequence information was missing fewer actions were performed correctly than when consequence information was not missing. There was no interaction for age groups.

Effects for the absence of two information types

Because not all information types are absent in the actual manual equally often, it is not possible to perform analyses for every possible combination of information types. We decided to perform analyses only for combinations

of the information-types that showed a main effect for absence (see table 6). The combinations that were analyzed were goal-action, goal-consequence, goal-identification, action-identification and action-consequence. The combination consequence-identification was not analyzed because there was only *one* instruction module in which identification information was absent and consequence information was not absent.

Table 6. Mean proportions 'correctly performed' actions when one of two information types was or was not absent, for both age group (only for actions that information was read about).
+ = Information type is not absent (in N information modules).
- = Information type is absent (in N information modules).

	Goal	+		-	
Age group (n)	**Action**	+ (10)	- (5)	+ (25)	- (17)
Young (10)		.667	.933	.736	.742
Old (13)		.579	.776	.344	.249
Mean (26)		.621	.844	.532	.486
	Goal	+		-	
	Consequence	+ (10)	- (5)	+ (31)	- (11)
Young (11)		.726	.735	.758	.625
Old (11)		.682	.403	.355	.221
Mean (22)		.703	.569	.549	.432
	Goal	+		-	
	Identification	+ (10)	- (5)	+ (27)	- (15)
Young (11)		.780	.762	.751	.687
Old (9)		.753	.300	.366	.306
Mean (20)		.766	.554	.551	.505
	Action	+		-	
	Identification	+ (23)	- (12)	+ (14)	- (8)
Young (11)		.755	.596	.818	.868
Old (10)		.501	.234	.581	.460
Mean (21)		.623	.415	.695	.683
	Action	+		-	
	Consequence	+ (31)	- (4)	+ (10)	- (12)
Young (7)		.745	.375	.729	.799
Old (10)		.463	.000	.500	.417
Mean (17)		.598	.187	.587	.616

Goal - Action. There was an interaction found for the absence of goal and action information (F 14.31, p <. 01). There was no interaction for age groups. In the absence of goal information, fewer actions were performed correctly if action information was absent as well. It seems as if the absence of more than one information type causes more damage than the absence of just one information type. But, in the presence of goal information, more actions were performed correctly if action information was absent than if action information was not absent. These results are contrary to expectations. Probably the same explanation that was given for the unexpected results for the absence of action information, applies here as well, i.e. the fact that a number of actions are too predictable.

Goal - Consequence. There was no interaction found for the absence of goal-information and consequence-information (F < 1). There was no interaction for age groups.

Goal - Identification. No interaction was found for the absence of goal-information and identification-information. An interaction with age groups was found (F = 5.89, p = .026): elderly people show better task performance when neither of the information types is absent.

Action - Identification. There was no interaction found for the absence of action-information and identification-information ($F = 1.49$, $p = .237$).
Action - Consequence. An interaction was found for the absence of action-information and consequence-information ($F = 10.86$, $p < .01$). When only action-information was absent, less actions were performed correctly than when both consequence- information and action-information were absent. These results are contrary to expectations. Perhaps the results can be explained because there were only very few young participants who had read information in all four conditions: only 7 young participants were involved in this analysis.

CONCLUSIONS AND DISCUSSION

General results. There are differences between age groups with respect to the use of the manual and task performance. Although both age groups read an equal amount of information in the manual, task performance was clearly different. Older participants performed fewer tasks correctly than younger participants did and they also finished fewer tasks than the other age group. This supports the hypothesis that elderly people indeed have more problems when working with a manual than other age groups.

Reading and task performance. Actions that information was read about were not performed better than actions that no information was read about. The first explanation one could think of is that the quality of the information is very bad and useless to the reader. Another explanation might be that readers decide to read only those parts of information they think they need. And apparently their selections are sensible: they were right to skip the parts of information they did not read, because their task performance did not suffer from it. This explanation is in accordance with Wright's 'theory for NOT reading' (18). Wright describes readers' motivations for starting to read in the first place, stopping to read and returning to read. According to Wright, one important reason for NOT reading is that readers believe they already know what is said in a section of a text, or that they believe they don't need the information in it. From this point of view, the fact that participants in the experiment perform the actions they read about equally well (or equally poor) as the actions they did not read about, indicates that participants only read information when they think they need to, i.e. when they think they cannot perform certain actions without instructions.

The absence of a single information type. First of all, it can be observed that even though some information is absent from the manual, both older and younger participants are able to perform some of the actions correctly, either with the help of the information that *is* in the manual or with the help of their foreknowledge. The absence of some information types had an effect on task performance. Especially the elderly participants suffered from the absence of goal and identification information. Apparently it is important for them to know why an action needs to be performed and which entity to perform it with. Younger participants apparently were better able to infer

this information from the information that was given. These results correspond to Cohen's results on older peoples decreased ability to make inferences (7). Cohen's results can not explain why effects of absence of information for the elderly were found especially for goal and identification information. The absence of consequence information yielded worse task performance for both age groups. Apparently, users need information that helps them control whether they performed an action correctly or incorrectly, so they know whether they can move on to the next step in a procedure.

The results for the absence of action information are contrary to expectations. Perhaps these results can be explained by the method that was used in constructing the criterion manual. Starting point in constructing the criterion manual were the actions: they were the skeleton for the criterion manual. For other information types it was judged (based on the user profile) whether they had to be specified. Action information though, was specified in every instruction module. Perhaps not all the actions had to be specified in the manual: possibly the criterion manual was too extensive at this point. The results in table 5 suggest that the presence of predictable action information (like 'point the front of the remote control directly to the front of the VCR') is counter-productive.

The absence of multiple information types. The interaction of the absence of goal information and the absence of identification information needs to be explained in relation to the main effects for the absence of each single information type. Knowing that especially elderly people suffer from the absence of just one of those information elements, it is easy to understand that the older age group performs best when none of these information elements is absent. When either one of them is absent the elderly perform much worse, while there is no difference in task performance for younger participants.

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