Procedural and Declarative Information in User Instructions: What We Do and Don't Know About These Information Types

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Abstract

The use and the effects of different information types in user instructions are not completely clear. Research showed that procedural information (information about the actions) is the most important information type during use. Research results about the effects of declarative information (explanatory information) are not conclusive. It is known that users are interested in declarative information, but it is not known in which situations they read this information and in which situations this information affects task performance. Furthermore, it is not clear which different types of declarative information have to be distinguished. In this paper, we describe what is known about different information types in user instructions and what is not yet known. On the basis of our analysis, we propose follow-up experiments and we recommend practitioners to consider the possible advantages and disadvantages of including declarative information in instructions for use.

Keywords: *user instructions, information types, declarative information, procedural information*

Introduction

User instructions contain different information types, such as actions that must be executed to get the product working, descriptions about the internal working of the product, advice about when to use a feature, and solutions to well-known problems. In the literature about instructive texts, these information types are classified in different ways. Usually, a distinction is made between information about the actions that must be executed while working with the product and the other information types. The precise definitions that are used to classify and name the information types differ from study to study (See [1] for an overview). In this paper, the common terms *procedural* and *declarative information* are used [2].

The benefits of declarative information in user instructions are not completely clear. User instructions might be effective if only procedural information is included. However, the benefits of declarative information are assumed in a number of theories and models [3], [4], [5], [6], [7], [8]. During the last twenty years, a number of experiments have been conducted to test the hypothesis that declarative information in user instructions results in a more elaborated mental representation of the device and that this representation positively affects task performance. However, the results of these experiments are not conclusive. Some experiments demonstrate positive effects of declarative information [2], [9], [10], [11]; other experiments do not [1], [12]. The experiments are difficult to compare because different types of declarative information were tested for effects and because the participants' tasks differed among the experiments.

Goal of this paper

This paper describes the results of both a literature study and a comparison of our own research results [1], [2]. This was the first step to deepen our insight into the functions of procedural and declarative information in user instructions. The main questions we addressed were:

- What is known about the use and effects of procedural and declarative information?

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- What is not yet known about the use and effects of procedural and declarative information?

We will conclude our paper with recommendations for practice.

What is known about procedural and declarative information

1. Procedural information is the central information type

Beyond doubt, procedural information is the most important information type in instructions for use. People read instructions because they want to know what actions they must execute to get their cell phone working, for example. They are not primarily interested in for example the internal working of a device. More than twenty years ago, Carroll and Mack [13] showed that users of instructions like to learn by doing and not by reading the manual. They concluded that user instructions have to be action-centered. Nowadays, there is no discussion about the importance of presenting the information in user instructions in an action-centered way. It is sometimes simply stated that the actions are the central part of instructions and that other information types are subordinate to this information (see for example [14], [15], [16]). However, although procedural information is the central information type in user instructions, the role of declarative information cannot be left out of consideration.

2. Users spontaneously read declarative information

It is questioned whether users are interested in declarative information. If users like to learn by doing and not primarily by reading instructions, why would they be interested in reading declarative information? This information type does not directly support the actions users have to perform. In several experiments, positive effects of declarative information on task performance have been proven, when participants were forced to read this information type, for example [9], [10]. In reality, however, users may skip information when considered irrelevant. If these participants would not have read declarative information if they were not forced to, we cannot conclude that declarative information leads to better task performance in real life. Therefore, it was necessary to examine whether users of instructions spontaneously read declarative information.

Ummelen carried out a series of experiments using the *click & read method* [2]. Her instructions included procedural and declarative text blocks that appeared illegible on a computer screen. By clicking on the blurred text with the mouse, this text block became legible. The block became illegible again when the participants clicked in another block to make that block legible. The computer logged the times that the different text blocks were legible. The users knew what information type would appear on the screen by clicking in the blurred text, because each text block had a legible and meaningful heading. The logged data showed that the participants spent approximately 35% of the total time on reading and using declarative information.

Karreman also measured the reading times of declarative information by using the click and read method [1]. The participants in her experiments could also decide which text blocks they read while operating the device. Her results showed that the participants spent between 20% and 25% of the total time on reading and using declarative information. Therefore, it can be concluded that users of instructions spontaneously read declarative information, even if the instructions allow them to skip the information.

3. Users spontaneously build a representation of the working of the device

A number of experiments showed that users of devices spontaneously build mental representations of the working of a device [6], [13]. If they can consult instructions, they use the instructions to build such a representation. Furthermore, even in the absence of instructions, users try to build a mental representation of the device, because they want to make sense of their experience.

Payne investigated the user's mental representations of bank machines [6]. Users of these machines do not receive declarative information about the internal working of the machine. (Besides that, at the time of the experiment, 1991, these machines were less common than nowadays.) However, Payne demonstrated that all participants had a mental representation of the working of a bank machine. These mental representations were very different from each other. Some participants believed, for example that a bank machine is 'intelligent', performing all the necessary computations to effect each transaction. Other participants believed that a

bank machine is a 'dumb' terminal to a central computer where all the records are stored and all the computations are performed (p. 12).

The results of Payne's study showed that spontaneously formed mental representations are not always correct. Sometimes, this does not negatively affect the user's ability to operate the device. For instance, although the hard disk of a computer is not truly divided in several maps that contain a number of files, users who think that a hard disk is organized in that way can use their computer without any problems. Sometimes, an incorrect mental representation does have negative effects on task performance. At the moment that the computer's hard disk needs to be defragmented, users who have a 'primitive' mental representation of a hard disk divided in directories and subdirectories will not understand why defragmentation can be useful, how it should be performed, and what happens during that process. It seems logical that declarative information that can be used for building a correct mental representation can result in better task performance.

What is not yet known about procedural and declarative information

1. What exactly distinguishes procedural and declarative information?

Although it is clear that procedural information is concerned with actions and declarative information is not about actions, the exact characteristics that determine the distinction between procedural and declarative information are not clear. Ummelen formulated detailed definitions of the two information types that are based on the content and the form of the information [2].

Procedural information consists of actions, conditions for actions, and results from actions. This information is characterized by action verbs and imperatives, relatively short action sentences, step by step presentation of items, direct style, and if … then constructions.

Declarative information is all explanatory information other than action information. It is characterized by modal verbs, relatively long fact sentences, continuous prose, indirect style, and modifiers.

These definitions seem to make a clear distinction between the two information types. However, some pieces of information can be classified as both procedural information and declarative information. For example, information about the results from actions can be classified as procedural because it is a direct result from a specific action and it is formulated as an if … then statement: 'If you press *home*, the cursor moves to the first cell of the page'. However, information about the results of actions can also contain elaborate descriptions about the working of the device. For example: 'If you press *#81#*, then this handset is connected to the base station, which means that all incoming calls ….' This information can be classified as procedural because it is formulated as an if … then statement. It can also be classified as declarative information because this information explains something about the working of the telephone system.

In future research, it has to be investigated which exact characteristics determine the distinction between the two information types. Obviously, the distinguished information types have to be relevant for the users. Therefore, it would be useful to investigate which information types users distinguish and which characteristics they use to classify these types.

2. Which subtypes of declarative information are relevant?

Although it is not exactly known how to define declarative information, it is known that declarative information is a heterogeneous information type. It can contain information about the internal working of the device, but also pieces of advice about when to use a specific feature. Different subtypes can be distinguished, but a usable classification has not been made so far.

In the majority of the studies about declarative information, the effects of *declarative information about the internal working of a device* are investigated. This information is called functional information [10], supportive information [17], or system information [1]. An example of this information type is: 'You have two lines at your disposal. You can use these lines simultaneously. This means that someone can make a telephone call while somewhere else in the house someone else is sending a fax or using the internet.'

This type of declarative information seems to be a relevant subtype. A number of experiments have shown that information about the internal working of a device affects the ability to operate the device. This information seems particularly useful to build an elaborated mental representation of the device and the task that has to be performed.
Other types of declarative information that might be relevant are *information about the interface of the device* and *information about how to make optimal use of the device*. An example of the first type of information is: 'The cursor can take different shapes. Usually, it appears in the shape of a small box in a cell …' (derived from [2]). An example of the second information type was found in the user instructions of a television:

> 'Have you ever fallen asleep in front of the TV, only to have it wake you up at two in the morning with a test pattern screeching in your ears. Well, your TV can save you all that trouble by automatically turning itself off.'

Karreman investigated the use and the effects of this last information type [1]. The participants in her experiments spent some time on reading this information type, but this did not result in better task performance.

Future research has to make clear whether these three subtypes of declarative information are relevant from a user's perspective and whether other relevant subtypes of declarative information can be distinguished.

3. Which user contexts are relevant?

The results of previous experiments that tested the effects of declarative information are difficult to compare, not only because different classifications of information types are used but the user contexts differed as well. In some experiments, participants had to perform one particular task with the aid of the instructions (for example, [5]). In other experiments, participants had to learn to work with a device or software program, knowing that they had to use this device or program in the future (for example, [17]).

Ummelen investigated different user contexts [2]. She compared the use and effects of three user groups: inexperienced users who had to learn to work with an unknown spreadsheet program, experienced users of spreadsheet programs who had to complete one particular task with the same unknown spreadsheet program, and users in between these two user groups. Ummelen's results showed that inexperienced users who have to learn to work with the program read relatively more procedural information. Probably, experienced users are more capable to find out by themselves which actions they have to perform. Because Ummelen did not distinguish between subtypes of declarative information, the results do not make clear what effect the user situation has on using different types of declarative information.

After a usable classification of declarative information types is available, it has to be investigated whether users in different situations use different types of declarative information. It can be assumed that users who have to execute a particular task only once are less interested in declarative information about the working of the device than users who have to work with a device on a regular basis.

4. In which situations or task components do users decide to use declarative information?

The series of experiments by Ummelen and Karreman demonstrated that users spend a considerable amount of time on declarative information [1], [2]. However, it is not exactly known when users feel a need for declarative information.

Karreman's first experiment is the only study that investigated at what moments users read declarative information [1]. The results showed that users spend relatively more time on reading two different types of declarative information before they start operating the device than during operating. The general pattern was that a user read the description of the task he had to perform, then he spent some time on reading declarative information, after which he selected the procedural information that he needed, and finally he performed the task with the aid of procedural information. During task performance, the users consulted the declarative information occasionally, for example when they encountered a problem. Karreman's results are consistent with Kester's hypothesis [17]. She assumed that presenting declarative information before task performance and presenting procedural information during task performance would result in better task performance than presenting all information simultaneously before or during task performance.

Future research has to test whether all types of declarative information are mainly read before the user starts to operate the device.

Recommendations for practice

Definitely, more research is needed to investigate the use and the effects of declarative information in user instructions. Users read it but it does not always result in better task performance. It is not clear which types of declarative information result in better task performance and in which user situations these types result in better task performance.

The research literature does not provide sound arguments for the advice to exclude declarative information from user instructions as long as the two information types are clearly separated and identified (with headings and other signaling devices). Then, users can easily decide for themselves whether to read the declarative information or not. Furthermore, declarative information must be easy to understand. Karreman's results indicate that reading declarative information can result in higher cognitive load and in lower confidence [1]. If declarative information is difficult to understand, the user's cognitive load might become too high. This might result in worse task performance.

Concluding, before instructions are written, the advantages and disadvantages of including declarative information in these particular user instructions have to be considered carefully.

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