Safety First? – Consumer Product User Guide Warnings as an Information Type

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Tutkielman tarkoituksena on selvittää, miten kuluttajatuotteiden käyttöohjeissa esiintyviä varoituksia voidaan teoriassa luonnehtia informaatiotyyppinä ja missä määrin tämä luonnehdinta pätee käytännössä. Aiempaan tutkimukseen nojautuen voidaan todeta, että tällaiset varoitukset vastaavat yleensä niitä koskevia standardeja ja suosituksia vain osittain. Näin ollen tämän tutkielman hypoteesina on, että varoituksia varten laadittava informaatiotyyppimalli ei täysin toteudu kuluttajatuotteiden käyttöohjeissa esiintyviä varoituksia tarkasteltaessa.

Teoreettinen viitekehys jakautuu kahteen osaan. Ensiksi siinä esitellään kuluttajatuotteiden käyttöohjeissa esiintyvät informaatiotyypit. Toiseksi siinä määritetään varoitusten ominaisuudet informaatiotyyppinä; tarkastelun kohteina ovat varoitusten sisältö, muotoilu ja sijainti. Lähteinä käytetään teoksia etupäässä seuraavilta aloilta: informaatiosuunnittelu, kielitiede, markkinointi, psykologia ja tekninen viestintä. Lisäksi teoriaosassa hyödynnetään kahta ISO:n standardia.

Aineistona käytetään varoituksia, jotka on kerätty kymmenestä voimatyökalun käyttöohjeesta. Varoitusten sisältöä, muotoilua ja sijaintia analysoidaan teoriaosasta johdetun, tarkistuslistaa muistuttavan työkalun avulla. Tutkimusote on etupäässä laadullinen aineiston suppeudesta ja kapea-alaisuudesta johtuen. Aineiston luokittelua sekä lukuja ja prosenttimääriä kuitenkin hyödynnetään siinä määrin kuin on tulosten raportoinnin riittävän tarkkuuden kannalta relevanttia.

Analyysin perusteella voidaan todeta, että hypoteesi pitää paikkansa. Aineiston varoitusten sisällössä, muotoilussa ja sijainnissa oli paikoin puutteita. Näiden alustavien tulosten vahvistamiseksi tai kumoamiseksi olisi tarpeen tehdä mahdollisimman laajamittainen määrällinen tutkimus, jossa käytettäisiin tilastollisia menetelmiä. Pienimuotoisemmat, tiettyyn tuoteryhmään keskittyvät tutkimukset olisivat myös hyödyllisiä. Lisäksi jatkotutkimuksen kohteeksi nousee jargonin käyttö varoituksissa.

Avainsanat: informaatiotyypit, kuluttajatuotteet, käyttöohjeet, varoitukset

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1. Introduction

"A man warned is half saved."
–German proverb

"With today's technology, warnings have become increasingly necessary. Products, equipment, tools, and the environment have become more complex; how they work, their composition, and their inherent hazards are frequently not obvious" (Wogalter and Laughery 1996, 33). This statement was true in 1996 and is even more true in 2011 because technology has developed considerably since then. And since technology is quite likely to keep developing at an ever increasing pace in the future, it is safe (and logical) to predict that warnings will consequently keep becoming more and more necessary. This is why I consider warnings a research topic worth pursuing.

I have chosen to examine consumer products, because consumers cannot be expected to have previous experience of the products they use and are therefore more susceptible to hazards than professional users. In this context, *warning* can be defined as follows: "A warning is a message from a knowledgeable source, generally the provider of a product, to a prospective user citing potential dangers in use and recommending actions that mitigate harm" (Zeitlin 1994, 172). Cox and Wogalter (2006, 114) argue that in an ideal situation this type of warning would be attached to the product, where the warning should remain throughout the product life cycle. However, some products have little or no space for this purpose, which is why warnings are often placed in instruction manuals and safety guides.

It must be noted here that warnings are not the only means of keeping people and property out of harm's way. In safety engineering, there is a hierarchical sequence of strategies for hazard

control. The first strategy is to eliminate or minimize the hazard through design, such as by omitting a blade from a device without affecting its functionality. This, however, is not always possible, as is the case with the powered lawnmower, for example. The second best hazard control strategy is to guard against the hazard, which refers to limiting contact between people and/or property and the hazard. This can be achieved by means of a physical barrier (e.g. protective goggles or gloves) or by designing safety mechanisms (e.g. automatic shutdown of powered lawnmowers when a certain handle is released). Warnings come third in the sequence because they are unreliable: "Depending on the circumstances, the person at risk may not see or hear the warning, may not understand it, may not believe it, or may not be motivated to comply with it". If all three strategies fail, there is no choice but to withdraw the hazardous product from the market in order to avoid further injuries or damages (Wogalter 2006, 4).

1.1 Why do companies issue warnings?

From the product manufacturers' perspective, the main purpose of warnings is to provide protection against liability litigation and trade bans that might be placed on their products due to breaches of safety standards (Lipus 2006, 76). The Hague Conference on Private International Law (1973, 1) states that manufacturers are liable for "damage caused by a product, including damage in consequence of a misdescription of the product or of a failure to give adequate notice of its qualities, its characteristics or its method of use." Similarly, the International Organization for Standardization (henceforth, ISO) states (1995, 1) that "Instructions for use should allow and promote correct use of a product and should directly help to avoid misuse which may lead to hazards." The ISO does not pass laws, but it does "provide governments with a technical base for

health, safety and environmental legislation . . ."[1] These two statements are the starting point for many governments' legislative branches; as Lipus (2006, 76) notes, most countries and courts consider product documentation a factor in product safety.

Putting the legal aspect aside, Lipus (2006, 76) states that from the consumers' perspective, warnings are one way for companies to "respect the rights of consumers to be treated as ends (as human beings with basic safety needs) and not merely as means to make a profit" and to "demonstrate care for consumers by providing information that meets those consumers' unique cultural and safety needs". On the other hand, according to Mayer and Scammon (1992, 354), companies may employ product warnings rather as means of gaining competitive advantage by designing warnings that clearly surpass the law-required minimum; as a result, consumers may perceive their products as safer than their competitors' offerings, which may result in increased sales. These two agendas may, of course, co-exist peacefully, but I am inclined to believe that when companies devote considerable effort to warning design, the emphasis is on the sales-driven approach.

1.2 Previous studies

According to Steehouder (2004, 1), guidelines and models for user instructions can be supported by three types of research. Empirical studies measure the effects of document variables on the performance of users, thus offering evidence, contraevidence, or refinements for existing guidelines. Theoretical studies aim to describe and explain the behavior of readers of instructions. To designers and writers, they provide a deeper insight in the underlying cognitive processes that determine success or failure of their work. Finally, careful analytical studies of collections of

[1] Source: http://www.iso.org/iso/about/discover-iso_what-standards-do.htm.

instructions can help to identify, describe, and evaluate strategies that writers and designers apply.

As regards warning-related research, empirical studies abound (see e.g. Adams et al 1995; Braun et al 1995; Cowley 2009; Drake et al 1998; Frantz 1993; Griffith and Leonard 1996; Leonard 1999; Trommelen 1997; Young 1992; Young 1998; Vigilante and Wogalter 1997; Wogalter et al 1999). Theoretical studies are also quite numerous (see e.g. Freeman 2003; Hancock et al 2001; Hancock et al 2005; Hellier et al 2000; Rousseau et al 1998; Wogalter et al 1989; Wogalter et al 1991; Zuckerman and Chaiken 1998). However, there are also studies that would have to be included in both categories because they combine empirical and theoretical elements (see e.g. deTurck et al 1999; Edworthy et al 2004; Viscusi et al 1986; Wogalter and Vigilante 2003). These studies measure the effects of document variables on the performance of users and aim to describe and explain their behavior. Due to this overlap, it seems reasonable to fuse warning-related empirical and theoretical studies together. A suitable title might be *user-based warning studies* because the focus is on users.

For the sake of uniformity, analytical warning-related studies might be renamed *material-based warning studies* because they do not involve users as test subjects and concentrate on analyzing warnings appearing in manuals, warning labels etc. It seems that compared to the abundance of user-based studies, the number of material-based studies is quite small (see Wisnievski 2005; Laakkonen 2006; Tebeaux 2010; Yeomans 2009). These four studies are in fact the only examples of this category that I was able to find.

1.3 Aims of this study

Since material-based studies are somewhat overshadowed by their user-based counterparts in the domain of warning research, my starting point is the desire to help promote the former category. I

will examine warnings appearing in user guides rather than product safety labels because the former are easier to acquire (e.g. via the Internet) than the latter. Furthermore, this study targets user guides for consumer products instead of products intended for professional users. This is because unlike professionals, consumers cannot be expected to have previous experience of the products they use and therefore their safety is perhaps more dependent on warnings. As for the type of consumer products that my analysis material concerns, I have chosen a category that is among the most dangerous in the consumer market: *power tools*. They can be defined as follows:

> A power tool is a tool powered by an electric motor, an internal combustion engine, a steam engine, compressed air, direct burning of fuels and propellants, or even natural power sources like wind or moving water. . . They are used in industry, in construction, and around the house for driving, drilling, cutting, shaping, sanding, grinding, polishing, painting, and heating.[2]

According to The Power Tool Institute – an American organization consisting of power tool manufacturers – all power tools are potentially dangerous if both general and tool specific safety instructions (i.e. warnings) are not followed carefully[3]. This claim is backed up by statistical evidence. For instance, in a report listing injuries in the EU in 2002-2004, there are three types of power tools among the ten most dangerous products in the "do-it-yourself" category: angle grinder, chain saw and circular saw (Zimmermann & Bauer 2006, 19). While users' carelessness and unwillingness to read warnings is undoubtedly a factor in power tool (as well as other consumer product related) accidents, warnings should meet certain criteria so that users are at least given an opportunity to learn to operate them safely. The aim of this study is to examine these criteria in theory and practice. I will try to answer the following questions:

- What are the characteristics of consumer product user guide warnings as an information type?

[2] Source: http://en.wikipedia.org/wiki/Power_tool.
[3] Source: http://www.powertoolinstitute.com/pti_pdfs/PTI_Safety_general_safety.pdf.

- To what extent is the information type model for warnings realized by actual consumer product user guide warnings?

The concept *information type* appearing in the first question requires a brief explanation. Arguably, the origin of information types can be traced back to cognitive psychology. More than 30 years ago, Anderson (1976, 78-79) made a distinction between *procedural* and *declarative* knowledge: the former is knowledge about how to do something, whereas the latter refers to knowledge of facts about the world. Coe (1996, 74-75) elaborates on these two concepts: before storing information into long-term memory, our brain categorizes it either as *procedural information* (e.g. motor skills, cognitive skills and reflexes) or as *declarative information* (e.g. events, facts and images). And as regards user instructions, Ummelen (1997, 22) states that ". . . procedural information is often defined as action information or 'how to do it' information; declarative information is often defined as descriptive information about 'how the system works.'" As far as I know, warnings have not been investigated from this perspective before. Thus, this study is breaking new ground.

Answering the first question lays the groundwork for finding the answer to the second one. My intention is to (1) construct a theory-based prescriptive model and (2) apply it to practice. I have certain expectations as to what the answer to the second question will be like. This is because three of the four material-based studies mentioned in section 1.2 above have a common denominator: the materials analysed were deemed more or less deficient.[4] The warnings did not fully comply with standards and/or theory-based recommendations (see Wisnievski 2005;

[4] The study conducted by Tebeaux (2010) differs from the other material-based studies in that it does not criticize the material being analyzed as such. Tebeaux investigated the evolution of warnings in tractor manuals and safety labels pertaining to tractors tested for use in Nebraska from 1920 to 1980; she also takes a quick glance at more recent developments in the industry. Her main point is that despite constant increase in both number and quality of warnings during the 60-year period, the fatality rates of tractor operators remained high, and the situation has not improved much since then. This is mostly due to tractor operators' negative attitude towards reading warnings.

Laakkonen 2006; Yeomans 2009). The problems that emerged can be divided into three main categories: content, form (both textual and visual formatting) and location. Therefore, I expect warnings in consumer power tool manuals to also have deficiencies in one or more of these areas. In other words, my hypothesis is that the information type model for warnings is not fully realized by actual consumer product user guide warnings.

Since this study is a much-needed addition to the scarce number of material-based warning studies, its primary target audience is the warning research community. However, I hope that it will also benefit practitioners. The theoretical information type model for warnings offers a solid foundation for warning design.

1.4 Materials and methods

Having chosen to analyze warnings in power tool manuals, the next decision to be made concerned the number of manuals to be included in the analysis. I decided to analyse ten manuals similarly to Pohjola (2007), because ten seemed like a suitable (and conveniently even) number. The total number of warnings in ten power tool manuals is sufficient for the purpose of illuminating any problem areas, but certainly not high enough to yield generalizable results. This study is primarily qualitative, but there are some quantitative elements involved. Statistical methods were not used, but the data was categorized and some figures and percentages were provided in order to report the results in sufficient detail.

The manuals were downloaded from the Internet in PDF format. An explanation of the selection criteria is provided in section 4.1. The warnings appearing in the manuals were then analysed by means of a tool derived from the discussion in section 3. The identification and

separation process of the warnings as well as the design of the analysis tool are explained in section 4.2.

1.5 How this study is organized

In order to determine the characteristics of consumer product user guide warnings as an information type, it is necessary to begin with a theoretical overview of the existing information types appearing in user guides. Section 2 sets out to construct a taxonomy of these information types by subdividing procedural and declarative information. The taxonomy synthesizes the views of several theorists from the fields of technical communication and information design. Section 2 finishes with a diagram summarizing the taxonomy.

In section 3, the characteristics of warnings are discussed in terms of content, form and location. The discussion primarily draws on sources from the domain of ergonomics[5] because it offers such an ample amount of warning research. Two ISO standards are also utilized to a great extent. In addition, sources from fields such as linguistics, marketing, psychology and technical communication will be made use of where appropriate. At the end of section 3, the results of the discussion are again summarized by means of a diagram. (This and the previous diagram are combined in Appendix B to form the final diagram in which warnings are integrated into the information type taxonomy.)

Now that the information type status of warnings has been established, it is time to put theory into practice and examine real-life warnings: section 4 contains the empirical analysis. Finally, section 5 provides the conclusion that summarizes the findings and suggests topics for future research.

[5] This field is also known as human factors in the US (Coe 1996, 2).

2. Information types in user instructions

It is necessary to begin by providing definitions for the basic concepts. Karreman et al (2005, 330) define procedural and declarative information in user instructions as follows:

> *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 . . . It can contain information about the internal working of the device, but also pieces of advice about when to use a specific feature.

These definitions devote equal amounts of space to describing content and form, which implies that these two elements are equally important features of procedural and declarative information. I would argue, however, that content is what determines whether a piece of information is to be categorized procedural or declarative because the content has an intended function for the user. If, for instance, a set of instructions for performing a series of actions is written in continuous prose, it is incorrectly formatted procedural information whose function is to instruct the user. Correspondingly, if a passage of text describing the internal working of a device is formulated as a step-by-step presentation of items, it is stylistically dysfunctional declarative information whose function is to explain something to the user.

This is certainly not to say that such formal shortcomings are irrelevant from the user's perspective. Carliner (2000, 567) declares: "Readers bring a set of expectations to a communication product based on its form. For example, readers expect user's guides to provide step-by-step procedures for the most common tasks . . . They also expect that the step-by-step procedures will be written in the imperative mood." This claim seems reasonable. Having read (or leafed through) a number of manuals before, most users have formed certain expectations. If a

user suddenly comes across a procedure containing a wealth of modal verbs, she is sure to be confused, but the modals do not turn the procedure into declarative information. It remains a procedure, albeit an incompetently written one.

It must be mentioned here that my content-driven approach to classifying information types was influenced by the Darwin Information Type Architecture (DITA), an XML-based information architecture for authoring, producing and delivering modular technical documents in various delivery methods (Namahn 2000, 1-2). In DITA, documents consist of topics that can be defined as chunks of information organized around a single subject. Each topic has its own information type. In other words: "Typically, different information types support different kinds of content" (Ibid.). The way I understand the quotation is that each information type is compatible with a specific type of content and if the content is changed to something else, the information type changes as well. DITA does not adhere to the basic division of information into procedural and descriptive categories[6], but I would argue that its content-based scheme can be applied to my purposes.

Even if content is given first priority, it is not always straightforward to differentiate between procedural and declarative information. Karreman et al (2005, 330) provide an example:

> [S]ome pieces of information can be classified as both procedural information and declarative information . . . 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.

The problem here is essentially not the if-then-construction but rather the fact that an action and its result are combined with an explanation of the internal working of the system. The example sentence runs counter to the recommendation given by Coe (1996, 75) who emphasizes

[6] In DITA, there are *three* basic information types: concept, task and reference topic (Namahn 2000, 2).

the importance of separating procedural and declarative information to facilitate users' information processing. Such sentences defy the division of information into two distinct types. In other words, even content-based classification of information is not perfect, but it is the best alternative.

In the following subsections, I will introduce one possible content-based taxonomy of declarative and procedural information that draws on a number of sources on information types. Formal characteristics will also be discussed, but they will play a supporting role. By presenting this taxonomy here I am laying the groundwork for the later classification of warnings as an information type.

2.1 Declarative information

Karreman et al (2005, 329) state quite clearly that, in their opinion, declarative information is the minor 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.

However, Karreman et al (2005, 328) also acknowledge that declarative information *might* be useful; they state that a number of experiments have been conducted over the past twenty years to test the validity of the hypothesis that declarative information in user instructions results in a more elaborated mental representation of the device, which in turn has a positive impact on task performance. However, they continue, the results of these experiments are contradictory and therefore inconclusive. Some experiments display positive effects of declarative information

while others do not. In addition, comparing the experiments is complicated by the fact that there was variation in participants' tasks and types of declarative information tested.

The importance of declarative information may lack conclusive empirical evidence, but it does not mean that this information type should be overlooked. Based on a synthesis of information type sources, I have divided declarative information into three significant subtypes: *introductory information*, *conceptual information* and *reference information*. These will be discussed in the following.

2.1.1 Introductory information

The *Table of Contents* functions as an outline of the document that shows users the way to information they need. The minimum requirement for the hierarchy of headings is that the topics of main sections and the first level of subsections are presented, naturally with page numbers. The headings and subheadings should contain verbs so that they effectively suggest what the user can do with the product. As regards layout, the scope and importance of each topic is clearly indicated with stylistic means, such as varying type sizes and styles, indentation and upper- and lowercase letters (Price and Korman 1993, 155-9). Horn (1989, 110-111) recognizes a similar information type, namely *Classification*, the division of specimens or things into categories using one or more sorting factors. He gives the following example: "We can divide this repair manual into the following parts…"

In addition to letting the user know what the instructions consist of, there should also be an *Introduction* that outlines the features of the product. Chapters and large sections also need to be started with introductions so that casual readers can quickly determine which part of the manual contains the information they are looking for (Price and Korman 1993, 163-4). A similar

information type is *Getting Users Started* is that eases the reader into the use of the product, introducing its main features (Price and Korman 1993, 169-178).

2.1.2 Conceptual information

The goal of *conceptual information* is to place instructions in their appropriate context by providing theory and background information, preferably supplemented by an ample amount of graphics. Conceptual information justifies the guidelines to users, helps them use specific information to make decisions and draws attention to interrelated information. One way of deepening the users' understanding is to define key terms. Conceptual information is primarily meant for advanced users, but it may also assist less experienced users in performing new procedures or in deciding which procedure fulfils their needs. (Hackos and Stevens 1997, 58, 61, 277). Arguably, then, Karreman et al's (2005, 331) *information about how to make optimal use of the device* is an example of conceptual information because it is most useful to "power users". Karreman et al (Ibid.) provide the following example of this information type: "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." After reading this passage, an experienced user probably wants to learn how to use the sleep timer, but a beginner, doubtful of his capability to master such an advanced function, might be less enthusiastic.

In Horn's (1989, 110-111) classification, there are two information types that can be categorized as conceptual information. Firstly, there is *Concept*, "a group or class of objects, conditions, events, ideas, responses or relations that all have one or more attributes in common; are different from one another in some other respect, and are all designated by a common name".

Concepts are used when there is a need to explain a term, idea or abstraction to the user. Secondly, *Process* is "a series of events or phases which take place over time and usually have an identifiable purpose or result (e.g. When the transmission shifts from neutral to first, the following events occur…). This information type is used when the reader needs to be told what happens. . *Process* seems to be quite similar to one of the subtypes of descriptive information identified by Karreman et al (2005, 330), namely *Information about the internal working of a device*. Here is their example of this information type: "You have two lines at your disposal. You can use these lines simultaneously. This means that someone can make a telephone call while someone else in the house is sending a fax or using the internet." Both of these subtypes describe what is happening inside the device, the difference being that *Process* describes a sequence of events whereas *Information about the internal working of a device* can also refer to a single event, or so one would gather from the above example.

Indexes and Glossaries are also conceptual in nature since they support the user in finding and comprehending information. A good index takes people to the content they need quickly and smoothly, whereas a glossary defines key terms and concepts (Price and Korman 1993, 271).

2.1.3 Reference information

Hackos and Stevens (1997, 64, 280) state that *Reference information* supports decision-making and tasks by providing data that users can look up when needed, either frequently or infrequently. Lists and tables are useful modes of presentation. Reference information is not supposed to be memorized or learned. Price and Korman (1993, 249-50) mention a somewhat similar information type called *Reference material*. Since it explains e.g. how an element of the product works or what happens during a process, this information type partially overlaps with Hackos and

Stevens' above description of conceptual information. The reason why I decided to include it in this category is that it is meant to be consulted when the need arises; in Price and Korman's words, "No one reads a reference chapter from beginning to end – at least, not voluntarily". Appropriately, Price and Korman have an example of reference material that, indeed, users turn to only when they must, namely technical specifications.

Horn (1989, 110-111) discusses two information types that can be classified as kinds of technical specifications. Firstly, *Fact* is statement of data without supporting information that is asserted with certainty (e.g. The wheel base of this car is 5 feet 3 inches…). Secondly, *Structure* is a physical object or something that can be divided into parts or has boundaries (e.g. The spark plug is composed of the following main components…). When the reader needs a description of the appearance or composure of an object, it is time to apply this type of information.

A third type of technical specifications is identified by Karreman et al (2005, 331) in the form of *Information about the interface of the device*, which is exemplified by the following: "The cursor can take different shapes. Usually, it appears in the shape of a small box in a cell . . ." This example is probably taken from software documentation, but similar passages might also appear in a manual for a television, mp3-player, navigator or some other complex device that includes a small computer. However, an interface does not have to involve graphics or text on a screen; it refers to all the parts of a device that are visible to the user and that are needed in interacting with the device. For instance, a coffeemaker manual might advise the user as follows: "The red light on the power switch indicates when the power is turned on."

2.2 Procedural information

A *Procedure* is a set of sequential steps that the user performs to obtain a specific result. This includes the decisions required from the user and the actions that must be performed as a result of those decisions. In other words, procedures tell the reader how to do something. (Horn 1989, 110-111) Hackos and Stevens (1997, 54, 66) argue that this information type aims to guide the user through the successful and immediate completion of the task, not to instruct the user how to perform the task independently. It is not to be confused with *instructional information* that teaches users how to perform tasks on their own in a continuous and consistent manner. Price and Korman (1993, 227) do not exactly agree with this distinction; they state that procedures are the core of a successful manual because they "encapsulate the skills of experienced users in a way that lets novice and intermediate users acquire those skills quickly-whenever they need them". In other words, Price and Korman's idea of a procedure captures the instructional aspect as well. This seems reasonable to me: the purpose of procedural information is to instruct the user to perform tasks, either on a short-term or a long-term basis. Therefore, the notion of instructional information seems irrelevant. According to Price and Korman (1993, 227), procedures consist of four elements: name, introduction, numbered steps and explanations. These are discussed in the following.

Procedures should be given meaningful names that refer to users' goals so that they can quickly and easily find what they are after. Ideally, all procedure headings contain the same grammatical form (such as a gerund or an infinitive phrase) that is limited to procedures; in this way, the form becomes an indicator of a section that includes procedures (Price and Korman 1993, 227-228).

Longer procedures should be introduced when users need additional information, e.g. when they are unaware of the appropriate context or prerequisites. An introduction[7] is supposed to give the user a brief overview—it should not describe the procedure thoroughly or contain any step-by-step instructions. There must be a valid reason for the presence of an introduction. It should not be used merely for its own sake (Price and Korman 1993, 230-232).

Numbered steps are the most central part of procedures. They describe a series of actions that the user needs to take to accomplish a goal. Because the majority of steps in procedures need to be performed in sequence, they should be numbered, which helps the users keep their place (Price and Korman 1993, 233-5). Hackos and Stevens (1997, 270) add that the steps should be presented in a logical order, i.e. in the order in which they are supposed to be performed. Price and Korman (1993, 233-5) continue that the number of steps should be limited (5-9 at the most) so that the users can remember and comprehend the entire sequence without difficulty. But if the procedure has only one step, bulleting should be used instead of numbering so that the user will not expect a second step. Bullets should also be applied when a procedure consists of several optional, equally important single steps. If one of these options needs substeps, it has become a separate procedure.

Each step in a procedure should begin with an imperative verb so that the user knows exactly what she is supposed to do (Hackos and Stevens 1997, 271). Another way to avoid confusion is to use identical phrasing when requiring the same action from the user more than once. A paraphrased instruction might be mistaken for a different action (Price and Korman 1993, 237, 241).

[7] This type of introduction is not to be confused with its declarative counterpart discussed in section 2.1.1. A "declarative introduction" outlines a product's features whereas a "procedural introduction" refers to a specific procedure.

According to Price and Korman (1993, 243-5), explanations that follow steps should be clearly separated from them (e.g. by typographical means). That way, beginners easily recognize the required actions whereas more experienced users can easily skip these follow-up paragraphs. There is a recommended sequence for the explanations:

1. Place any warnings immediately after the potentially hazardous instruction.
2. Discuss any novel ideas appearing in the instructions.
3. Indicate the result of performing a step, especially if the user might consider the result surprising, strange, unfamiliar or inconspicuous. Descriptions of events that take place underneath the user interface level should be avoided unless they are absolutely necessary. Excessive cross-referencing is also unadvisable.
4. If the sequence is counter-intuitive, motivate the user to perform the next step.

In addition to these elements, the explanation should anticipate possible errors and tell the user how to detect them and how to recover from them. This type of problem-solving information together with warnings is what van der Meij and Gellevij (2004, 9-11) call the "unwanted states component of a procedure."

It is worth noting here that the first element in the above sequence for explanations recommends that warning(s) should be placed *after* the step that might be hazardous to the user. This practice seems illogical; how is the user supposed to exercise caution in performing a potentially hazardous action if the warning is given *afterwards*? Moreover, the explanations in which the warnings occur should clearly stand out from steps *so that expert users can easily skip them*.

There is a reasonable explanation for Price and Korman's warning-related recommendations that at first glance seem irresponsible. Their book discusses software and hardware

documentation, a field in which there is seldom need to warn against hazards that threaten the health or lives of users. Software errors and hardware malfunctions tend to be relatively harmless (excluding the electrical hazards that the latter may involve). In fact, according to a piece of research conducted by van der Meij and Gellevij (2004), only 20 of 104 software and hardware manuals (52 each) contained warnings. Moreover, 20 was also the total number of warnings since each of these manuals contained just one warning (8 in software manuals and 12 in hardware manuals). For the sake of comparison, Laakkonen (2006) studied safety information in motorcycle manuals and found a total of 503 warnings in six manuals.

The significant point emerging from Price and Korman's above discussion is that they consider warnings one of the elements appearing in procedures. In addition to this "downplayed" safety information related to information technology, the only reference to warnings in my information type sources is offered by Horn (1989, 110-111). Among his information types is *Principle*, which is a statement that, among other things, tells what should or should not be done (e.g. rules, policies or guidelines, warnings or cautions). In other words, all that Horn has to say about warnings is that they are a subtype of principle and that they give either commands or prohibitions. His example is not particularly helpful, either: "…the principle of road safety can be stated…". I would argue that warnings (or cautions) are the only subtype of *Principle* that can be applied to user instructions. The other subtypes are more relevant for other types of texts. But in any case, Horn's idea of warnings must also be classified as procedural information since it has to do with actions (see Karreman et al's definition of procedural information on p. 15).

2.3 Overview of information types in user instructions

The following diagram shows the hierarchy of the information types discussed so far:

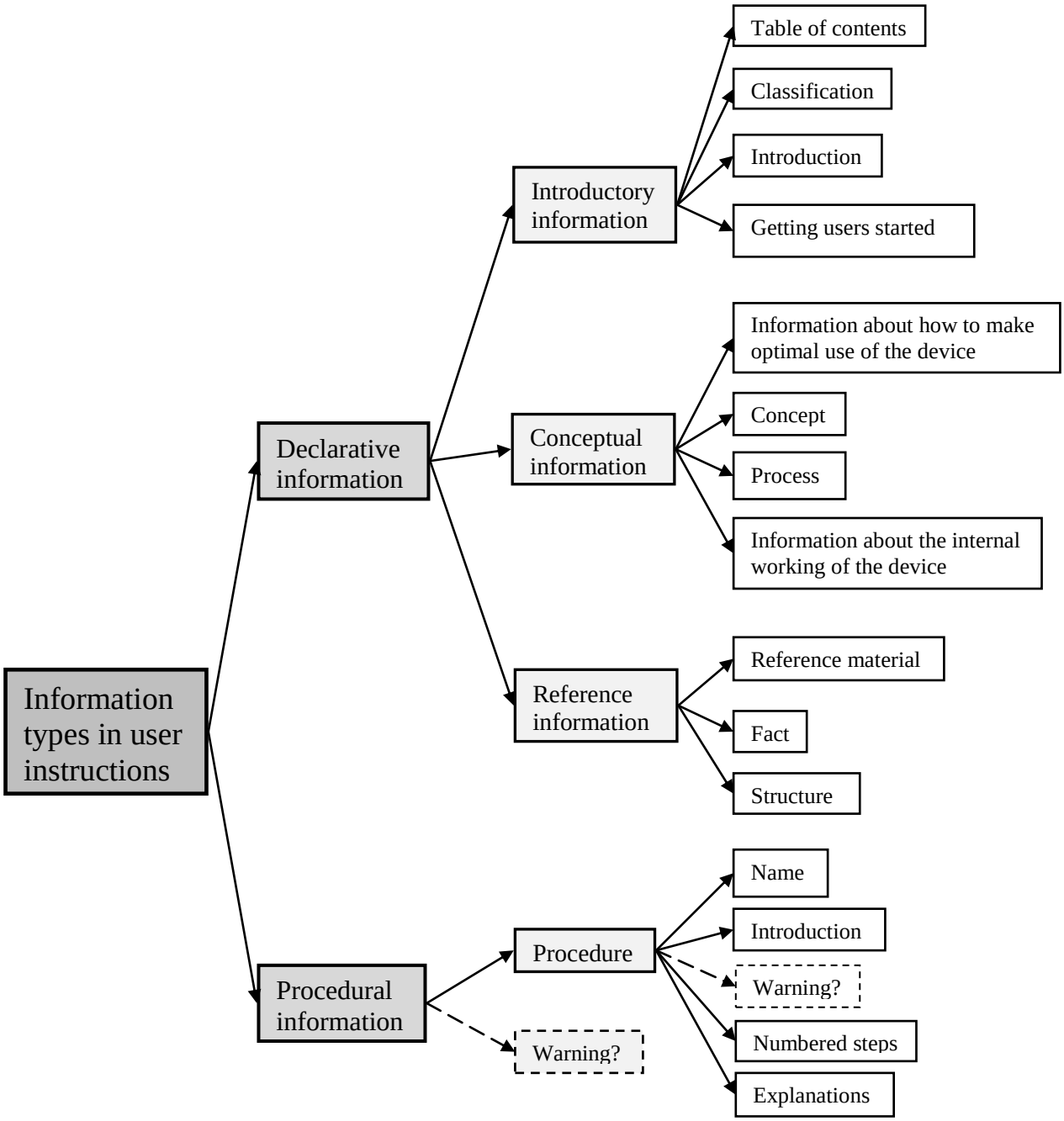


Diagram 1. Information types in user instructions.

The diagram indicates by means of dotted lines and question marks that at the moment there are two possible placements for warnings. Firstly, based on what Horn argues (see p.11), warnings could be a subtype of procedural information. Secondly, warnings could be a subtype of Procedure, as Price and Korman (see p. 9) contend. More specifically, they regard warnings as a part of Explanations, which means that they would appear after the potentially hazardous procedures. But as I stated on p. 10-11, their focus is on relatively harmless software and hardware documentation. To be able to apply their idea to user instructions in general, I decided to locate this second potential placement between the Introduction and Numbered Steps.

In order to complete the above diagram and to define warnings as an information type, it is necessary to determine their informational characteristics. To achieve this, warnings will be discussed in the following section in terms of content, form and location.

3. Warnings as an information type

Whether a warning is needed or not is highly context-dependent. *Existing knowledge* denotes a situation in which it may not be obligatory to provide warning information because the target audience already has such information or knowledge (Laughery and Smith 2006, 421). However, at this point I would like to revisit what I stated in the introduction: unlike professionals, consumers cannot be expected to have existing knowledge. A part of the target audience will be completely unfamiliar with the product, and it is this novice portion that determines how many and what kinds of warnings are needed. Laughery and Smith (2006, 421) continue that the term *open-and-obvious*, in turn, "essentially refers to circumstances or situations where the appearance and/or function of a product or environment communicates the appropriate warning information". The application of this concept is not always straightforward; what is open-and-obvious to the product designers and warning developers may be perceived differently by the target population. Hazards that are not open-and-obvious to the target audience are known as *hidden* hazards (Manning 1997, 1-2). As Leonard and Wogalter (2000, 384) assert, it is these hidden or less known hazards that most vitally need to be warned against. By "less known", they refer to the potential media coverage. Car accidents usually receive publicity if they cause fatalities or several injuries, and an unusual incident such as a tree falling on a person may also be publicized. However, a possibly unusual event such as the ingestion of an overdose of iron tablets by a young child is unlikely to be newsworthy, even if the child needs treatment by professionals. Parents who are made aware of the possibility of such an event and the danger involved will be more likely to take appropriate precautions.

In other words, there are several factors that must be considered in designing a successful warning. I will examine these factors in the three following subsections, the themes of which are content, form and location.

3.1 Content

Wogalter et al (1987, 599) list four warning design criteria related to content:

- *Signal word*. Warnings should have signal words appropriate to the level of hazard (e.g. "DANGER", "WARNING" and "CAUTION").
- *Hazard statement*. Warnings should tell the user what the dangers are.
- *Consequences*. Warnings should motivate users to comply by emphasizing the results of failure to heed.
- *Instructions*. Warnings should tell people what they should or should not do to avert danger (i.e. the do's and don'ts).

The above sequence of warning elements is merely one possibility as Wogalter et al do not explicitly state that the elements should appear in this order. The ISO does not prescribe any specific sequence, either. Naturally, the placement of the signal word in the beginning of the warning seems like the only rational solution so that the user immediately understands the level of the hazard, but the appropriate positions of the rest of the elements are less straightforward and therefore subject to discussion. For instance, Kylänpää and Piirainen (2002, 122) recommend that the instructions should be the initial element of a warning. Leaving aside the fact that they do not mention the signal word or its appropriate placement at all, their recommendation raises the question whether instructions should appear before hazard statement and consequences. In a study conducted by Friedmann (1988, 514) almost 20% of the subjects read only the first

sentence of the warning because they wanted to skip to instructions for use. Perhaps they regarded the warning unimportant partly because there was “noncritical” (quotation marks in the original) warning information in the first sentence (such as “DANGER: Hazardous to the eye”). The implication for warning design is that “the most critical warning information – that is, the information regarding how a person can protect himself or herself – should be presented first” (Ibid.).

The content elements of warnings will be discussed in more detail in the following. Hazard statement and consequences will be discussed in the same section because they are closely related; in my opinion, both of these elements are represented in the ISO (1995, 6) recommendation that a warning should “explain the nature of the hazard (and, if appropriate, its causes).”

3.1.1 Signal word

Hellier and Edworthy (2006, 407) define signal words as “single terms that are used to denote the overall level of hazard implied by a warning”. ISO (1995, 6) acknowledges the three signal words mentioned above and prescribes a hierarchy for them: CAUTION refers to a low risk, WARNING to a medium risk and DANGER to a high risk. Naturally, ISO (2004, 2, 4) also provides exact definitions for these words:

- CAUTION is “used to indicate a potentially hazardous situation which, if not avoided, could result in minor or moderate injury”
- WARNING is “used to indicate a potentially hazardous situation which, if not avoided, could result in death or serious injury”

- DANGER is “used to indicate an imminently hazardous situation which, if not avoided, will result in death or serious injury”.

In addition to these, ANSI Z535.4 Standard for Product Safety Signs and Labels, the corresponding American standard, contains a fourth signal word, NOTICE, which is defined as “the preferred signal word to address practices not related to personal injury” (Peckham 2007, 9). Fuller and Sulsky (1995, 2238) refer to this type of messages as *consumer advisement warnings* and continue that they serve three purposes: making the product easier to operate; preventing property damage that may result in costly product returns; and reducing the need for customer service that handles consumer questions or complaints. It can be argued that such pieces of information are not warnings at all because the worst possible consequence of non-compliance is mere product damage. Thus it makes sense that the ISO does not regard NOTICE as a signal word. I introduced it here because it is mentioned in a number of studies discussed below.

Naturally, ordinary consumers are not familiar with these definitions, and yet, as Hellier and Edworthy (2006, 407) point out, the association of signal words and the severity of the hazards they refer to must be as consistent as possible throughout the target population. There is little room for individual interpretations. Drake et al (1998, 298-299) had their test subjects match signal words (the ISO set accompanied by NOTICE and DEADLY) and their definitions. The low scores on this task indicate that some terms (e.g., WARNING) do not convey the meanings they are supposed to. The participants were successful in assigning definitions for the terms at the extremes of the hazard scale (DEADLY, DANGER, and NOTICE), but the definitions of the intermediate terms (WARNING and CAUTION) tended to be connected to higher level signal words. This implies that people tend to underestimate the degree of hazard that the words are supposed to convey relative to their assigned definitions. For example, the definitions for the

term WARNING were frequently matched with the term DANGER because the definitions for WARNING are apparently considered stronger than the term itself conveys. Wogalter and Silver (1995, 2203) offer an explanation for this: WARNING has lost a great deal of its strength to connote hazard because it is used so widely in non-safety-related contexts, such as "WARNING: discount coupons will expire at year's end" or "WARNING: batteries not included." Words like REMINDER or NOTE might be better options on these two contexts, whilst HAZARD or UNSAFE might substitute for WARNING in potentially hazardous situations.

Drake et al (1998, 299) also measured their participants' judgments of the signal words along seven dimensions: degree of hazard, likelihood of injury, carefulness, severity of injury, intention to comply, immediacy of consequences, and understandability, which they combined to form a single score called overall injury potential. The general trend in the participants' evaluations indicated that DEADLY, if available, was given the highest rating, followed by DANGER, WARNING, CAUTION, and NOTICE. Independent of the presence of DEADLY, significant differences were found between all terms except WARNING and CAUTION. Drake et al (1998, 299) comment on this finding as follows:

> Unfortunately, government, manufacturers, employers, and standards bodies may assume people can discriminate between these two terms with respect to the hazard level that they convey when this and other research says that they do not. Even with the definitions in hand people have difficulties relating them to the words.

Young (1998, 108) also presents results that do not flatter the official set of signal words prescribed by ISO, namely CAUTION, WARNING and DANGER. His additional signal words (one of which is in fact NOTICE prescribed by ANSI) mixed in with the aforementioned ones were more successful. DEADLY, LETHAL and DANGER were considered the most severe, differing to a great extent from CAUTION and NOTICE at the other end of the scale.

WARNING had little or no difference to DANGER or CAUTION but it was clearly distinguished from the two extremes, DEADLY/LETHAL and NOTICE. In other words, the three standardized signal words are too close to each other in terms of perceived hazard level. Based on these results, Young proposes two possible solutions to this problem; first, the current three-level hierarchy could be replaced with a new one (DEADLY or LETHAL vs. WARNING vs. NOTICE); second, the middle level could be dropped altogether in favour of a two-tiered scheme (DEADLY, LETHAL and DANGER vs. CAUTION and NOTICE). The first possibility seems quite reasonable, assuming that DEADLY *or* LETHAL means that only one of these options is to be chosen for the final scheme. According to Drake et al's results (1998, 299) DEADLY might be a viable option. In contrast, Young's latter proposal is somewhat confusing to me because there are several options on each level. Are these supposed to be used interchangeably? Would it not be better to have just one signal word per hazard level?

In other words, the empirical evidence as regards the official set of signal words is not very convincing. Griffith and Leonard (1996) do report that their test subjects commonly ordered the four signal words similarly to the sequence in which they appear in (American) standards (NOTICE, CAUTION, WARNING and DANGER). Wogalter et al (1994) also discovered that the hazard rankings given to the signal words CAUTION, WARNING and DANGER by their test participants correspond to the hierarchy prescribed in standards, but they found no significant difference between the perceived hazard levels of the signal words. This spurred Wogalter et al (1994, 554) to criticize the current system and to propose a different approach:

> Rather than assigning arbitrary distinctions between terms of similar meanings and then expecting people to come to know the underlying definitions (as is the case with the current standards), a better procedure would involve basing the selection of terms on their extant meaning to the target population. The only appropriate way to do this is to base the selection on empirical data from those groups. Such data-based selection approaches would obviate the need for costly training programs and would avoid the common problem of not

being able to educate all of the relevant individuals at risk, such as many ordinary consumers.

But are the distinctions between these terms indeed arbitrarily assigned? Even though I have presented several studies that have criticized the signal words, I still find it difficult to believe that they would have been selected carelessly or at random, given that distinguishing between them can be a matter of life and death. In order to find out what the signal words "officially" mean, I consulted the Oxford English Dictionary Online[8]. Here are the most relevant definitions for the context of safety information:

- NOTICE: "Formal or official intimation or warning of something; public announcement or notification."
- CAUTION: "A word of warning; a caveat, monition; a hint or advice to anyone to take heed."
- WARNING: "Advice to beware of a person or thing as being dangerous."
- DANGER: "Liability or exposure to harm or injury; the condition of being exposed to the chance of evil; risk, peril."

Notably, DANGER is the only signal word that refers directly to harm and injury (albeit not death) while the others denote a notification of something to beware. The meaning of the second strongest signal word, WARNING, is advice to heed something that involves *danger*, which does not quite set it apart from the meaning of DANGER. CAUTION and NOTICE, in turn, both contain the word *warning* in their definitions, meaning that they are virtually synonymous with WARNING.

On the basis of these dictionary definitions, I find it surprising that test subjects have perceived any difference between the signal words. The standard organizations' dictatorial

[8] Source: http://www.oed.com

practice of choosing the signal words without testing them on the target population seems quite unwarranted. How can the organizations be sure that the signal words have the desired effect?

3.1.2 Hazard statement and consequences

According to Laughery and Smith (2006, 419), a hazard statement (or "hazard information" as they call it) "is intended to communicate a set of circumstances that may result in personal injury or property damage." Danska et al (1993, 27-28) elaborate on this notion and list three elements that the hazard statement should comprise: what the hazard is; the situation in which the hazard occurs; and the factors that increase the likelihood of the occurrence of the hazard. According to Heaps and Henley (1998, 344-346), the cause of the hazard should not be merely implied but rather directly stated. In their experiment investigating attitudes towards household cleaner warning labels, the statement "Top Scrub contains N-Alkyl" made the warning more credible than the more vague "Top Scrub contains a hazardous agent."

Likelihood information, in turn, may not be that useful. Wogalter et al (1991, 77) argue that the likelihood of an accident does not have much influence on people's evaluations of the hazardousness of a product. Severity of injury is by far more significant. In fact, Wogalter et al (1993, 105) discovered that when people are asked to estimate injury frequencies related to consumer products, the results are distorted because injury severity influences their risk judgements. Laughery and Smith (2006, 425) subscribe to the idea that consequences overshadow likelihood and speculate that it may be due to the relative rarity of accidents while using products; people do not consider such accidents very likely and therefore do not find likelihood information that useful, either. People may also have a tendency to focus their

attention on possible outcomes instead of likelihood when thinking about accidents in their everyday lives.

Concentrating on consequence information, then, is recommendable because it increases the effectiveness of warnings. But should this information be explicit? Laughery et al (1993, 598-599) argue that consumers are entitled to warnings with explicit consequence information in order to make informed buying decisions. However, manufacturers are reluctant to include explicit details in their warnings because they assume that their sales figures would suffer. Laughery et al (1993) set out to prove this assumption wrong. They investigated people's attitudes towards explicit consequence information in warnings related to different kinds of products in a series of four experiments. The results indicate that the level of detail has no clear connection to buying behaviour, but graphic warnings do make users more cautious when using products. In a similar experiment, Heaps and Henley (1998, 346-348) found that an explicit expression of consequences was easier to remember than an implicit one, but explicitness did not make the test subjects less likely to use the product. Thus, manufacturers have no excuse to be unnecessarily discrete.

In other words, being explicit is recommendable, but there are a few points worth considering as to the content of explicit warnings. Laughery and Smith (2006, 427) note that explicitness does not necessarily equal quantitativeness. Numbers can be helpful, especially as regards specifying time, frequency, amount and so forth, but the numbers in a warning must be useful to the target audience. In addition, the use of technical jargon is usually not a recommendable way of being explicit, especially with a general target audience. Jones (1998, 120) agrees with this claim: audience is the key factor in determining how technical a piece of documentation should be. A

technical writer must be absolutely sure that the target audience understands all the technical terms used.

Jones' argument is quite compelling, especially when applied to consumer product warnings: because technical terms and jargon are primarily a means of professional communication, including them in warnings meant for a lay audience should be avoided. In most cases, it should be possible to replace a technical term with a simpler expression. For instance, *risk of electric shock* is a clearer and therefore more explicit way of communicating an electrical hazard than the less direct *high voltage* because at least some of the target audience may not comprehend what the latter phrase is attempting to warn about.

ISO (1995, 4) assumes a relatively lenient stance towards technical terms in the following statement (concerning user instructions in general): "Unavoidable technical terms should have their meaning explained." This approach probably works well with some parts of a user guide, such as assembly instructions, but not with warnings because they lose a great deal of their expressive power if they contain technical terms that the user does not immediately understand. The user will hardly bother to check what the term means; instead, she is likely to deem the warning incomprehensible and skip to something more useful.

3.1.3 Instructions

As regards instructions, the ISO (1995, 6) simply states that clear guidance on what to do and what to avoid should be provided to the user. Instructions concerning precautions need to address actions that are (in the user's perception as well as in reality) relevant, effective in mitigating the hazard, and low-cost in terms of time, money, and effort (Riley 2006, 296). Wogalter et al (1987, 610-611) refer to the cost element of warnings as *cost of compliance*; their research results

confirm that the less time and effort is required to comply with a warning, the more likely the warning is to modify behaviour. Their study did not involve money, but it seems fairly obvious that the monetary cost that may be required from the user in order to avoid a hazard should be kept to a minimum. For instance, if the use of protective gloves is prescribed, they should be provided with the product.

Danska et al (1993, 27) distinguish between two aspects of hazard avoidance: *how* to avoid the occurrence of the hazard and *what* to avoid if the hazard occurs. The latter point seems rather irrelevant: if the user has encountered a hazard and sustained an injury, it is often too late to *avoid* anything. If any instructions are given in case of an accident, they should rather concentrate on what to do in order to minimize damage and/or prevent any further injury. Danska et al (1993, 27) have also taken this into account: the user should be told what steps need to be taken in order to render the product safe. The instructions should also give advice on necessary first aid in case of an accident caused by the hazard. Unfortunately, however, the ISO (1995, 1) does not require this kind of instructions from product manufacturers: "Instructions for use should allow and promote correct use of a product and should directly help to avoid misuse which may lead to hazards." As regards instructions appearing in warnings, product manufacturers' responsibility does not extend beyond providing precautions.

3.2 Form

Besides content, form is also a crucial factor in communicating a safety message to the user. Friedmann (1988, 507) has an effective way of putting it: "If a warning contains the appropriate information to make it legally adequate but the information is presented in such a way that it does not influence consumer behaviour, then that warning is virtually useless." I will discuss the

appropriate form of a warning in the following subsections, starting with grammatical factors and moving on to visual factors, i.e. font, colours and pictorial elements.

3.2.1 Textual factors

Wogalter et al (1987, 599) state that warnings should be concise, i.e. brief and to the point. But what exactly can be regarded as "brief"? One possible criterion is offered by the Plain English Campaign (2009, 1): the average sentence length of clear writing should be 15-20 words. Balliro et al (2003, 30) have a slightly more lenient approach: they recommend 15-25 words on average; in addition, they limit the length of each individual sentence to "about 30 words". Kemnitz (1991, 71) provides some (more or less) useful advice for keeping the word count low:

> To say as much as possible in as few words as possible, you must learn not to waste words. For example, you should avoid adjectives unless they provide crucial information. Also, avoid strings of words where a single preposition will give the same meaning. Write in a telegraphic style: Eliminate articles and pronouns, and all forms of the verb 'to be'.

The avoidance of adjectives and unnecessary strings of words is perfectly reasonable. However, the recommendation of telegraphic style would seem like exaggeration in the context of user instructions and is probably more suitable for product labels with very limited space.

Danska et al (1993, 42-43) also advocate brevity and add that each sentence should contain only one theme. A related recommendation for keeping the sentence structure solid is that "One sentence should normally contain only one command, or at most a small number of closely related commands" (ISO 1995, 4). In my opinion, limiting the complexity of sentences is quite sensible because it not only promotes comprehension but also seems like an effective way to conserve words.

Naturally, being brief is not the only textual factor in warning design. The ISO (1995, 4) provides the following guidelines for commanding the user with clarity:

- use actives instead of passives
- be assertive
- use action verbs instead of abstract nouns
- speak directly to the user.

An example of each guideline is shown in the following table adapted from ISO (Ibid.):

Table 1. ISO guidelines for commanding the user with clarity.

Recommendation	**Like this**	**Not like this**
Use the active voice	Turn off power	Be sure that the power has been disconnected
Be assertive	Do not remove tabs	The tabs should not be removed
Use action verbs	Use, keep, avoid	Utilization, maintenance, avoidance
Speak directly	Pull black lever towards you	Users will pull the black lever away from the machine

Predictably, the use of active instead of passive when providing instructions is supported by several sources. Danska et al (1993, 42-3) carefully state that active is *generally* better than passive, but do not provide any examples of a situation in which passive would be more appropriate. Indeed, it is quite difficult to think of such a situation in this context. Leech and Svartvik (2002, 346) note that passive is particularly associated with impersonal style – such as scientific and official writing – in which the identity of the agent is irrelevant or unknown and therefore need not or cannot be stated. This is certainly not the case with user instructions. As Reep (1997, 138) argues, passives confuse the user because she cannot tell who is supposed to perform the action. Therefore, instructions and direct orders should always be written in active voice. Kemnitz (1991, 71) adds that the active clearly shows the connection between the hazard

and the consequences; strong auxiliary verbs should also be used "to supplement the active voice and ensure that the observer understands the true nature of the hazard." The latter argument is corroborated by Edworthy et al (2004) who present empirical results to prove that probabilistic statements in which the level of hazard is expressed as *may*, *might*," or *could*, rather than definitively, are the least appropriate expressions for communicating risk.

However, it is worth remembering that *could* appears in the ISO definitions of two signal words. CAUTION designates hazards that " . . . could result in minor or moderate injury" whereas hazards appearing under WARNING " . . . could result in death or serious injury". Moreover, *could* is what makes the difference between WARNING and DANGER, the most severe signal word indicating hazards that "will result in death or serious injury". Considering the research results mentioned above, it is debatable whether such probabilistic expressions are suitable for hazard statements. But since they appear in standardised definitions, product manufacturers adhering to the standard are likely to formulate their hazard statements accordingly.

The importance of being assertive when commanding the user should be quite obvious, especially in the context of warnings where non-compliance may result in injury or even death. One way of achieving a sufficient level of assertiveness is using the imperative. It can be defined as "a grammatically distinct clause construction whose members are characteristically used to issue directives" (Huddleston and Pullum 2002, 32). And yet, as the Plain English Campaign (2009, 6) notes, the fear of using commands is commonly manifested in expressions such as "customers should do this" or "you should do this" instead of just "do this". "Please" is also used to avoid rudeness. The problem with *should* is that while it does imply the speaker's (or in this case, writer's) authority, it does not imply the writer's confidence that the recommendation will be

carried out (Quirk et al 1985, 227). *Please* does not belong to warnings either because according to Quirk et al (1985, 832) it "may be added to imperative sentences with the illocutionary force of a request to convey greater overt politeness . . ." In other words, *please* turns commands into requests which the reader can refuse. Instead, *must* is a valid choice; Carter and McCarthy (2006, 654) state that it expresses obligation and that its negative form *must not* can be used in prohibitions.

The use of action verbs instead of abstract nouns is exemplified in the above table by *use*, *keep* and *avoid* instead of *utilization*, *maintenance* and *avoidance*. More specifically, these abstract nouns are nominalizations. According to the Plain English Campaign, (2009, 7), the use of nominalizations instead of the verbs they are based on obstructs textual flow. Nominalizations merely denote entities instead of expressing actions, which means that they make sentences uneventful. Naturally, this kind of effect is undesirable when giving commands because the actions required from the user may become implicit.

Speaking directly to the user is perhaps the most self-evident of these ISO guidelines, at least when applied to warnings. The example of indirect address, "Users will pull the black lever away from the machine", is so artificial that it is quite unlikely to appear in user instructions. In any case, the Plain English Campaign (2009, 5) also recommends that the reader should be addressed as 'you', as if the reader was sitting across the desk from the writer. It is worth noting here that using the imperative is also a means of direct address: as Leech and Svartvik (2002, 173) state, *you* is the implied subject of sentences with an imperative verb that lack an expressed subject.

There is one textual factor that the ISO does not mention at all: whether positive statements are more appropriate than negative ones or vice versa. This is rather surprising, because many of

my other sources address this issue. The most passionate exponent of positive forms is Harbaugh (1991, 74), who argues the following:

> Information offered in positive form strikes the mind with undiminished force simply because it is *affirmative*. That makes it more definitive, meaningful, and memorable than negative information. The human mind instinctively seeks affirmative information and prefers it to negative information.

Pohjola Vakuutus Oy (1991, 21) concurs and claims that research has shown that people understand and remember positively expressed instructions ("extinguish your cigarettes") better than negative ones ("do not keep your cigarettes lit"). This does not exemplify the inferiority of negative forms in instructions very successfully, because the positive expression here is considerably more common and natural than the negative one which has an artificial feel to it. If we take a different pair of commands such as "keep your hands away from the spinning blade" vs. "do not touch the spinning blade", the positive option no longer prevails, simply because it is longer.

This notion is supported by some of my sources. Kemnitz (1991, 71) advises warning designers to use positive forms whenever possible but admits that sometimes negatives are necessary, e.g. when providing hazard avoidance instructions. In such cases, one should "opt for forcefulness over a positive mood". Heaps and Henley (1998, 348-349) offer a research-based example of this: they report that "Do not get in eyes or skin. Do not swallow." was more effective than the less forceful "Avoid contact with eyes or skin. Avoid taking internally." The latter statement increased warning believability and recall.

Danska et al (1993, 42-43) go one step further and claim that although positive expressions are usually easier to understand and remember, with safety instructions negatives may be categorically more effective. Laakkonen (2006, 22) thinks along the same lines:

> In my view, "do not smoke", for example, is more direct, more forceful and clearer than "avoid smoking". So, I believe negative statements can be more effective and are totally acceptable in some cases when communicating safety information and giving instructions. Directness and clarity are, in this context, more important than expressing all information in a positive form.

On the other hand, however, in some cases the positive may in fact facilitate forcefulness, directness and clarity. Balliro et al (2003, 31) aptly point out that multiple negatives can make sentences difficult to understand. They demonstrate this argument with two examples: "Do not unlock the door" vs. "Keep the door locked" and "This may prevent you from avoiding injury" vs. "You may be injured." Especially in the second example the positive sentence is clearly easier to comprehend.

In my opinion, categorical statements in favour of the positive or negative are beside the point. Directness, forcefulness and clarity should be given first priority in warnings. Neither positive nor negative forms have any intrinsic value; it is entirely case-specific which one is more suitable.

3.2.2 Visual factors

A warning must be able to capture the user's attention. As Leonard (1999, 500) puts it, "The importance of attention to warnings cannot be emphasized too much. If a warning is not attended, it is equivalent to having no warning." Indeed, if the user misses the warning because it does not stand out from the surrounding text, its content and wording have no value, no matter how well-crafted they are. A warning must be *salient*, i.e. it must call attention to itself by means of design features (Wogalter 2006, 3). This property is also known as *conspicuity* (Wogalter et al 1987, 599).

There are several visual elements that can be utilized in warnings to attract attention. One of these is the appearance of the warning text. As ISO (1995, 4) states, warnings should be typographically differentiated from their surroundings by using a different type face, type size, or some other means of making them conspicuous. As for type face, Wogalter and Laughery (2006, 906) recommend the use of "plain, familiar, nonfancy font" in warnings. More specifically, they suggest that signal words and larger text should be typed in a serif font (e.g. Arial or Helvetica) and smaller text in a sans serif font (e.g. Times or Times New Roman). These recommendations make sense: while an exotic font (e.g. Comic Sans) may serve to capture attention, it may also discourage the user from reading more than a few words from the beginning of the warning.

As regards signal words, the ISO (2004, 5) decrees that they "shall appear in upper case and bold fonts". Wogalter and Laughery (2006, 906) support upper case in this context, but they also suggest that it can be utilized for "specific emphasis". This, however, does not seem reasonable because the use of upper case outside the domain of signal words would probably decrease their salience. Therefore, a more recommendable method is to reserve upper case (and perhaps also bolding) exclusively to signal words and use other means such as italics for highlighting purposes.

Another way of distinguishing the signal word from the rest of the warning is to increase its font size. Silver and Braun (1993, 623) discovered, rather surprisingly, that a two-point difference between signal word and body text size was considered more readable than a four-point difference. They speculate that with the four-point difference the signal word overshadows the main body of the warning, whereas the two-point difference treats both elements as equals and conveys the warning as a whole. However, they continue with the hypothesis that if the size difference was terminated altogether, the salience of the warning would be adversely affected,

which would lower the perceived readability. Downsizing the signal word may also decrease the alarming effect of the signal word. Adams and Edworthy (1995, 2221, 2235) present results showing that the font size of the signal word (seven variables ranging from 8 to 32 points) has a linear relationship to perceived urgency. However, urgency was at least partially in conflict with aesthetic merit. In other words, the most alerting designs were not considered the most pleasing to the eye. In my opinion, though, conspicuousness and urgency are considerably more significant than the aesthetic experience. Exaggeration is not a good idea, either, because a disproportionately large signal word can be distracting, but the primary function of the typographic design of warnings is not to offer a feast for the eyes but to attract attention.

Typographic elements are not the only visual factors to consider when designing a warning. The ISO (2004, 6) recognizes seven basic types of *product safety label*[9] layouts:

a) single safety sign;

b) single safety sign used with a separated supplementary safety information text panel;

c) single safety sign used with a separated supplementary safety information text panel which includes a hazard severity panel;

d) combination product safety label not incorporating a hazard severity panel;

e) combination product safety label incorporating a hazard severity panel;

f) multiple product safety label not incorporating a hazard severity panel;

g) multiple product safety label incorporating a hazard severity panel.

The central concepts *safety sign* and *hazard severity panel* will be discussed in the following. For illustrations of safety label types b) – g), see Appendix A.

[9] The ISO uses this term of *warning* throughout the standard (ISO 3864-2) where this quotation is from because the standard is primarily meant to regulate the visual design of safety labels attached on products.

A *safety sign* can be both a product safety label type of its own and an element of other types of product safety labels. There are three types of safety signs categorized according to what kind of instruction they attempt to communicate to the user. The following figure demonstrates the three categories and provides an example of each:

Fig. 1. The three safety sign categories and an example of each.

A mere safety sign posing as a warning may seem quite inadequate, but it is worth noting that ISO 3864-2 allows warnings without text mostly because it must be able to account for product safety labels with very limited space. Another reason might be that the standard has been conceived with the European Union's interest in mind. The free movement of products combined with the large number of languages spoken inside the EU would make it difficult to provide text even if the safety label had enough space for it. The manufacturers cannot anticipate which

countries the product will be used in during its life cycle and therefore are not able to determine what languages to include on the safety label (Ross 2005, 34).

But it seems quite unlikely that the bare minimum, a single safety sign, would successfully communicate all the safety information to the user. Perhaps this is why the ISO (2004, 19) later on has a change of heart and revises the earlier directive (bolding mine):

> This part of ISO 3864 sets forth the requirement that either through the use of **two or more safety signs, or one or more safety signs with text**, the product safety label should alert persons to a specific hazard and identify how the hazard can be avoided.

This is a slight improvement, although even "two or more safety signs" without text is still quite likely to be inadequate. In any case, the ISO is not consistent in its requirements, which must be highly confusing for warning designers attempting to adhere to the standard.

As regards product documentation, the ISO (2004, v) acknowledges that graphics-only safety information *may* be insufficient and provides the following recommendations:

> Because the amount of safety information necessary to operate or service a product safely may be more than can be conveyed in a product safety label, a product's accompanying documentation(e.g. product literature, installation manual, operation manual, service manual) may supplement the product's safety labels to provide the user with the additional information necessary for safety. A product's user documentation also offers a place to educate users on the meaning of the safety signs and supplementary safety information symbols shown on the product's safety labels . . .

It is quite surprising that in this passage the ISO does not *require* manufacturers to include additional safety information in product documentation. Instead, only subtle recommendations are given where a more authoritative tone would have been in order. But again there is an inconsistency: later on, the ISO (2004, 11) provides a more assertive recommendation:

> It is important that the meaning of a product safety label be clearly understood by those who use or service the product. To increase the understanding of a product's safety labels, product manufacturers are strongly encouraged to incorporate information that will help people understand the meaning of the product's safety labels in their product's user documents (e.g. operation manuals, instructions, safety literature, service manuals, etc.). . .

Further, one way of increasing the target audience's understanding is "reproducing the product safety labels in the product's accompanying documentation" (ISO 2004, 11). I could not agree more, but the difference in tone between this quotation and the previous one is striking. I would assume that the standard was written by a team of authors, but it is no excuse for the lack of uniformity.

Moreover, there could have been references in *ISO 3864-2* to *ISO/IEC guide 37: 1995*, the standard that governs the textual content of user instructions, including warnings. The cooperation between these two standards is non-existent. Perhaps the best solution to this problem would be to publish a single standard dedicated to both content and formatting of safety instructions in product documentation. The American National Standards Institute, for instance, has produced such a standard, namely *ANSI Z535.6: Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials* (Hall et al 2006, 1).

The ISO (2004, 11) delivers one of its more authoritative recommendations by demanding that whenever safety signs are used in product safety labels, they should be reproduced and their meanings should be explained in the user documentation by means of captions as follows:

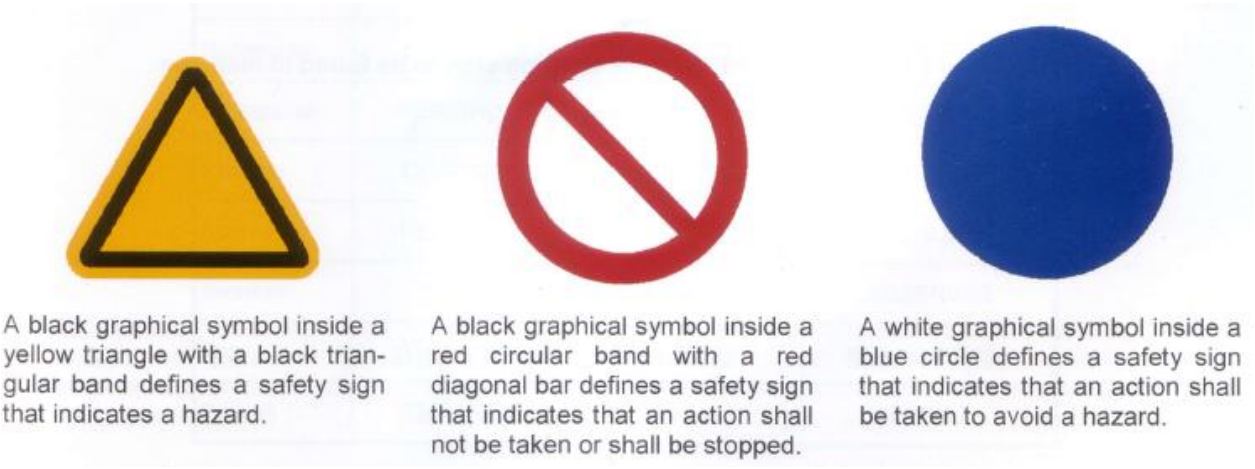


Fig. 2. Recommended way of introducing safety sign types.

The second and third captions include the unnecessarily formal *shall* as part of a passive structure (*shall not be taken*, *shall be stopped* and *shall be taken*). As Leech and Svartvik (2002, 173) state, the use of *shall* to express obligation is normally limited to official regulations and other formal documents. These are prime examples of the kind of legalese-type register that is commonplace and acceptable in standards but should not appear in product documentation. The passive structures should be rephrased as *you must not take*, *you must stop* and *you must take*.

In any case, it is worthwhile to provide these explanations. Wogalter and Sojourner (1997, 540) investigated the comprehension and retention of safety-related pictorials (i.e. safety signs) before and after training the participants on their meanings by providing verbal descriptions. The comprehension scores measured immediately after training improved from the pre-training scores. Moreover, the comprehension level was retained one week later and did not decrease significantly in a follow-up test six months later. Notably, it is the combination of text and images that explains these positive results; either element alone would not have been committed to memory in an equally effective manner. Therefore, pictorials should be presented in combination with their associated verbal explanations in order to facilitate their comprehension and retention. What the ISO could learn from this is that all the individual safety signs should be explained, not just the three types (warning, prohibition and mandatory action).

Perhaps the most central of all safety signs is the *general warning sign*. The ISO (2004, 11) provides the following guidance for this sign:

> When used, the meaning of the general warning sign should be explained in the user documentation. Where literature accompanying a product refers to potential hazards, the general warning sign may be used alone or in combination with the proper signal word to draw attention to the nature of the hazard. The following illustration may be used for this purpose.

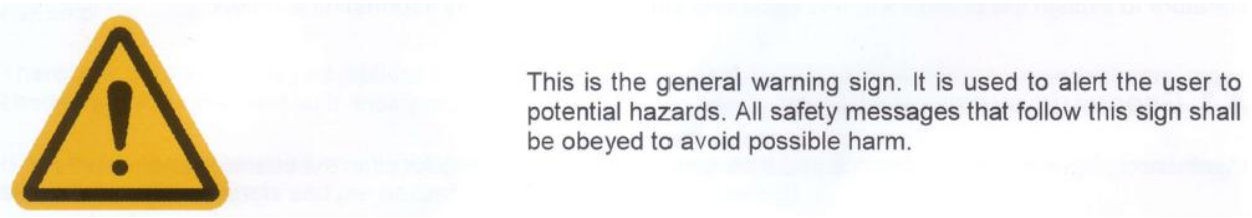


Fig. 3. The general warning sign accompanied by the recommended explanation.

The ISO can certainly be blamed for producing ambiguous recommendations, but at least they consistently use *shall* and the passive in these captions. This time, they even address the user as "the user" instead of *you*. The use of such language in user instructions is prohibited in *ISO/IEC guide 37: 1995* and required in *ISO 3864-2*. The ISO seems to elevate itself above its own guidelines.

However, the real problem here is not how the general warning sign should be introduced to the user but the design of the sign itself. Barnett and Wambaja (2000, 1) highlight three flaws of the sign (which they call "the international safety alert symbol"):

> With the adoption of the international safety alert symbol, the safety profession has lost an important weapon in the war against injury. [1] The symbol is not uniquely associated with safety, [2] it does not have an optimum shape and [3] it has no intrinsic pictorial to communicate danger to untrained people from every culture. The symbol represents a tragic "missed opportunity" for mobilizing personal vigilance.

Firstly, the power of the safety alert symbol to accentuate safety issues is decreased when the symbol is used for a large number of other purposes. Each non-safety-related appearance of the symbol corrodes its effect. Restricting the symbol to safety related matters is regrettably too late because its other uses are too widespread. Examples include software error messages, various websites and even dictionaries. In these contexts, the symbol's function is to draw attention to issues that have nothing to do with safety (Barnett and Wambaja 2000, 4). It can, of course, be argued that software error messages such as virus protection or firewall alerts often call attention to issues that may entail property damage, but these warnings hardly involve injury or death.

Secondly, Barnett and Wambaja (2000, 3) assert that the shape of the safety alert symbol is not ideal. They base this argument on a study conducted by Riley et al (1982) in which the participants evaluated 19 simple geometric shapes in terms of their suitability for warning indicators. The table on the following page is adapted from Riley et al (1982, 739) by Barnett and Wambaja (2000, 3) and displays the shapes in a decreasing order of preference:

Ranking	Shape	Description
1		Equilateral triangle pointing downward (traffic yield shape)
2.5		Square on a point or diamond (traffic warning sign)
2.5		Octagon (traffic stop sign shape)
4.5		Equilateral triangle pointing right (traffic no passing shape)
4.5		Equilateral triangle pointing upward (traffic yield shape)
6		Hexagon
7		Six-sided figure (slow moving vehicle sign shape)
8.5		Equilateral triangle pointing left
8.5		Parallelogram on a point
10		Pentagon (similar to school crossing roadway sign)
11.5		Trapezoid on its long base
11.5		Trapezoid on its short base
13		Parallelogram on its side
14		Circle (railroad crossing roadway sign shape)
15		Rectangle on its long base (similar to traffic information sign)
16.5		Square on its base
16.5		Ellipse on its major axis
18		Rectangle on its short base (traffic regulator sign)
19		Six-sided figure (tag shape)

Fig. 4. Geometric shapes ranked according to their suitability for warning indicators from best to worst.

As Barnett and Wambaja (2000, 3) note, the most preferred shape for indicating a warning is an equilateral triangle pointing downward, which means that the international safety alert symbol (equilateral triangle pointing upward) is upside down.

Thirdly, the general warning sign lacks intrinsic meaning: viewers do not recognize that it is a safety sign without training. Depicted below are Barnett and Wambaja's (2000, 4) examples of three types of symbols followed by a black-and-white version of the safety alert symbol:

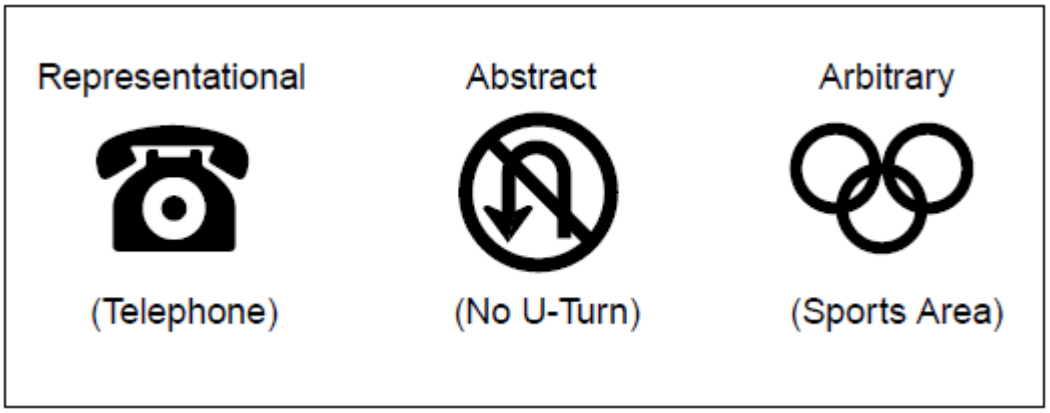


Fig. 5. Examples of representational, abstract and arbitrary symbols.

Fig. 6. Safety alert symbol in black and white.

It is easy to agree with their notion that the safety alert symbol/the general warning sign must be categorized as arbitrary because it lacks intrinsic meaning. This has also been empirically proved. Cairney and Sless (1982) investigated the comprehension of safety symbols by European, Vietnamese and Australian adults with literacy problems. The participants were asked about the meanings of 19 signs in two test sessions with one week in between. When the respondents identified a sign successfully, they were informed of it; when they did not, the correct answer was given. The purpose of the follow-up test was to determine how well the test subjects were able to learn symbols that they initially failed to identify. One of the worst performing symbols was the 'Caution' sign (i.e. the international safety alert symbol). Due to literacy problems, very few participants recognized the exclamation mark. Furthermore, the lack of a definite, concrete referent made the sign difficult to learn. This result prompted Cairney and Sless (1982, 96) to state that "it seems open to question whether, in view of an extensive range of warning signs related to specific hazards, such a non-specific sign is justified."

Barnett and Wambaja's (2000, 5) proposition for the replacement of the safety alert symbol is shown on the following page:

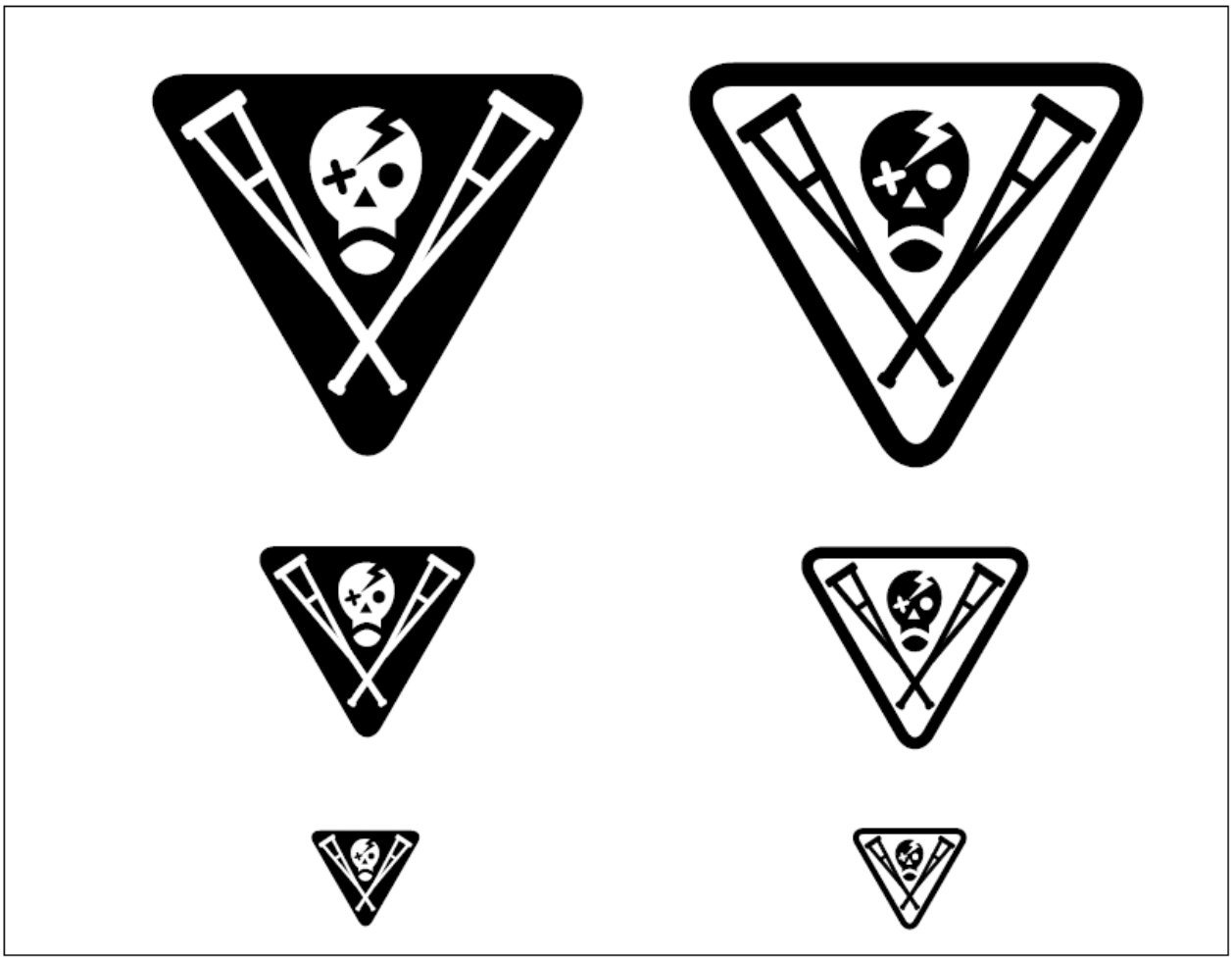


Fig. 7. The proposal for the replacement of the safety alert symbol in two alternate formattings and three sizes.

Their arguments in favour of their proposition are presented in the following:

> The triangle with its downward facing vertex was selected since it is the optimum shape; furthermore, the particular collection of graphics is clearly unique. An attempt was made to depict a general image of danger as opposed to a specific accident scenario. The crossed crutches are supposed to imply a leg injury; an eye injury is represented; a head fracture is illustrated; and finally, a death skull with a pained expression is included. It was hoped that this combination of maladies would not suggest a common cause and that the smorgasbord of mischief would imply general notion of danger. Whether this goal was achieved with this symbol is not important. What is important is that some symbol attain such a goal so that all viewers will perceive a danger communication.

In other words, their point was not to create a valid candidate to take over the duties of the current symbol (they even call their proposition "doodling"), but rather to highlight the importance of the creation of a universal danger graphic. However, the magnitude of such a project would be gigantic because the new symbol would have to be tested with focus groups assembled from *every single culture in the world*. In the meantime, the general warning sign will have to do.

The general warning sign appears in all of the ISO-approved *hazard severity panels*. The three types of panels are displayed below along with the explanations to be provided in product documentation (ISO 2004, 12):

Fig. 8. ISO's three types of hazard severity panels with explanations.

Again, the use of passive is quite unjustified. One way of improving these explanations would be to switch to active and split them up, e.g. *DANGER indicates a hazard with a high level of risk. If you do not avoid this risk, it will result in death or serious injury*. But as for the colors, the logic behind them seems relatively straightforward: yellow stands for the lowest level of hazard, red for the highest and the compound, orange, for the middle level.

These panel formats are also fully recognized by the corresponding ANSI standard, *ANSI Z535.4 Standard for Product Safety Signs and Labels* (Peckham 2007, 2). NOTICE is to be formatted as follows (Hall et al 2006, 2):

Fig. 9. ANSI's recommended formatting for the fourth hazard severity panel.

This formatting is clearly distinct from the injury-related panels: the general warning sign is missing and the prescribed color is not from the same scheme as the others.

But how well does the color coding as a whole actually work? Griffith and Leonard (1996) studied the association of colors with signal words. Significant correspondence between signal words and their respective colors was found only between red and DANGER. Yellow was strongly associated with both CAUTION and WARNING while the other color-signal word pairs (blue-NOTICE and orange-WARNING) were quite weakly supported by the data. Chapanis (1994, 274) examined the perceived level of hazard of the same set of the ISO signal words CAUTION, WARNING and DANGER in combination with the colours white, yellow, orange and red. The strongest finding was that DANGER on a red background communicates the greatest hazard whilst CAUTION and WARNING have no significant difference. These two words combined with different colours produced quite mixed results and the only straightforward conclusion to be made is that white is the poorest choice.

In other words, red-DANGER seems to be the only combination that successfully denotes the intended level of hazard. Leonard (1999, 504) speculates that this might be due to people's exposure to red as a signal of danger in other contexts such as traffic lights and stop signs. This prompts him to propose that the salient characteristics of red would be utilized to the full by

employing it as the only color associated with injury-related warnings, even though such practice might weaken its power to highlight more serious warnings. In my opinion, such extensive usage of red might indeed decrease its expressive force, similarly to the ubiquitous application of WARNING (see p. 18 above) and the general warning sign (see p. 38 above).

Even though there is little empirical evidence supporting the ISO's color coding, the use of color does have its proponents. Braun et al's (1995, 185) research results show that people consider color labels overall to express more hazard and to be more readable than black-and-white labels. Manning (1997, 3) adds that when colour printing is available, it is advisable to follow the standardized colour recommendations to make the warning more visible, and to reinforce users' recognition of warnings through consistency. I find this statement appealing because increasing the salience of warnings is what the standardized formats are essentially attempting to achieve. The current recommendations may be less than ideal because they are not research-based, but in the lack of better standards, warning designers do not have much choice.

There is one more warning design element left to discuss: borders. The ISO (2004, 6-10) does not have a strong opinion on the matter: three out of the seven prescribed safety label formats have an obligatory border surrounding the whole warning. The few research articles on the subject that I managed to gain access to present conflicting results. Young (1992, 35) argues that borders improve the noticeability of warnings, whereas Laughery et al (1993, 54) found little or no effect and Cowley (2009, 84) even contends that the impact of borders might be negative. Based on common sense, I see no other option but to agree with Young here. It would seem reasonable that borders help the user to distinguish warnings from the rest of the textual material on the page.

3.3 Location

Besides content and form, location is also a significant factor that warning designers need to consider. Manning (1997, 3) states that the location of a warning affects its ability to be noticed and read. As I mentioned in section 3 (see p. 13 above), in an ideal situation the warning is permanently attached on the product, but this is often not possible due to space constraints. Therefore, it is important to determine the optimal location(s) for warnings within instruction manuals.

One possible location is relatively easy to eliminate. Wogalter et al (1987, 610) state that warnings are more effective when they are located in the beginning of the instructions, because they are less likely to be read if placed at the end. Given only these two alternatives, the beginning of the manual certainly seems superior because it makes no sense to position warnings on the final pages. As Reep (1997, 208) notes, readers' attention must be drawn to the potential hazard or damage before they begin to follow instructions.

Thus, user instructions often include a section dedicated for safety information that is located in the beginning of the manual. This practice is based on the assumption that users will not miss the safety information if it is compiled on the initial pages (Robinson 2004, 4). However, this assumption has been proved wrong. According to a study conducted by Schriver (1997, 213), about 80% of consumers either scan through their manuals or use them as reference. Therefore, as Robinson (2004, 5) writes, the safety page is easy to neglect. A more recommendable method is to embed warnings within the instructions wherever they are needed. It is worth noting here that embedding warnings does not entail disguising them as ordinary instructions. Embedded warnings should still be made conspicuous, but the textual flow should not be interrupted more than necessary.

Robinson's recommendation receives some support. Wogalter and Laughery (2006, 896) provide the following argument: "In general, warnings should be located near other information that will be needed to perform a task". This view is also shared by Frantz (1993, 131) who studied the effect of location and presentation format of safety information in on-product instructions for a drain opener. The research subjects read one of four different labels before using the product. Moving the safety information from "Precautions" into "Directions for Use" improved reading rate from 37% into 89% and compliance rate from 48% into 83%.

Frantz (1993, 151) states that, based on his results, downplaying the salience of safety instructions by moving them from "Precautions" to "Instructions for use" increased attentiveness and compliance "because subjects were generally searching for task-related information within the user instructions". It is important to note, however, that the relocated warnings were all task-specific (e.g. "NEVER POUR DIRECTLY FROM CONTAINER INTO DRAIN"), whereas in all four versions of the product label, general safety warnings (e.g. "HARMFUL OR FATAL IF SWALLOWED") were placed in the "Precautions" section. Frantz claims that in two of the label variants safety instructions are completely integrated into usage instructions, but that is incorrect. (He also asserts that the embedded warnings are not highlighted in any way, even though they are capitalized throughout.) In any case, Frantz's research results seem to imply that general warnings can be located in the beginning of the instructions whereas task-specific warnings should be positioned to the appropriate context. My interpretation may not be compatible with Frantz's views, but that is how I decipher his rather cryptic piece of research.

In a later study investigating instructions on the label of a can of water-repellent sealer, Frantz (1994, 545) asserts that *precautions*[10] should be integrated into procedural information, but this time "the recommendation to include precautionary information in usage instructions does not imply that the same precautionary information cannot also be included in a separate warning section." In addition, he states that "to the extent possible, precautions should be presented in a procedurally explicit manner." In other words, Frantz finds redundant warnings quite acceptable but stresses the importance of procedural explicitness. In my opinion, warnings integrated into procedures cannot retain their procedural explicitness if reproduced in a separate warning section, at least when instruction manuals for complex products are concerned. Replicating an embedded warning in a procedurally explicit format in the beginning of the manual would require the reproduction of a great deal or all of the relevant procedure, which seems unreasonable.

A more efficient approach is to divide safety information into general and task-specific warnings (Reep 1997, 72; Danska et al 1993, 27-28). If a warning pertains to the entire manual, it is to be categorized as a general warning and placed in the introduction (Ibid.). Furthermore, as the safety page tends to include several warnings, recommendations are given as to how they should be organized. Reep (1997, 72) states that when describing the degrees of hazard of several procedures, it is advisable to use the descending pattern to alert the user to the matter most in need of attention. Danska et al (1993, 27-28) give a more specific advice: safety instructions should be organized in a descending order of damage severity. Vigilante and Wogalter (1997, 284) agree with this view in their study that identified a preferred ordering of product manual warnings for three power tools. Warnings that conveyed the most important information for the

[10] By precautions Frantz refers to the instructional element of warnings, i.e. what users should or should not do in order to avoid danger (see e.g. p. 15 above). For some reason, however, on a few occasions he uses the expression "precautions and warnings" as if they were two different concepts.

safe use of the tool and could result in the most likely and most severe injuries if not complied with were preferred to be placed first. These warnings also tended to contain information critical for the initial use of the product. The warnings that gravitated towards the bottom of the list tended to contain information that was not as specific or critical for the operation of the tool and that would become useful at a later stage, i.e. information concerning storage, maintenance, part replacement, and cord maintenance.

As for task-specific warnings, Balliro et al (2003, 49) recommend that if they apply to an entire section of the instructions, they should be located in the beginning of that section. Danska et al (1993, 27-28) maintain that such warnings should be separated from user instructions (they also want prohibitions and commands in general to be divided in distinct groups) and placed in the beginning of the relevant paragraph. This recommendation makes sense if step lists are regarded as a special kind of paragraphs and if the warning involves the entire procedure. But if only one hazardous step in the procedure is concerned, placing the warning before the procedure does not stand to reason because the user will falsely think that the warning pertains to the entire procedure. Perhaps Danska et al are reluctant to integrate warnings into procedures because they fear that users might mistake prohibitions for commands with dire consequences. But some authors argue that task-specific warnings should be located before the step (Manning 1997, 3; Reep 1997, 208). On the basis of these arguments, it would seem reasonable to state that the optimal location of a task-specific warning is determined by its scope, i.e. whether it pertains to a single step, a single procedure or an entire section.

Classifying warnings into two categories based on the extent of information they refer to is a recommendable practice because it decreases redundancy; ISO (1995, 6) recommends the avoidance of frequent repetition of warnings because it undermines their effectiveness. ANSI has

taken this kind of categorization even further by introducing a four-tier system in *ANSI Z535.6: Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials* (Hall et al 2006, 3-4). I will not discuss that rather clever system here because I have chosen to emphasize ISO standards, but I do hope that sometime in the future ISO will include something similar in a standard dedicated to user instructions.

3.4 Overview of warnings as an information type

In the diagram in section 2.3 (see p. 12-13), I sketched two possible placements for warnings in the information type diagram: a subtype of Procedural information and a subtype of Procedure. Now that I have introduced some new information, it is time to present a new diagram that illustrates warnings as an information type:

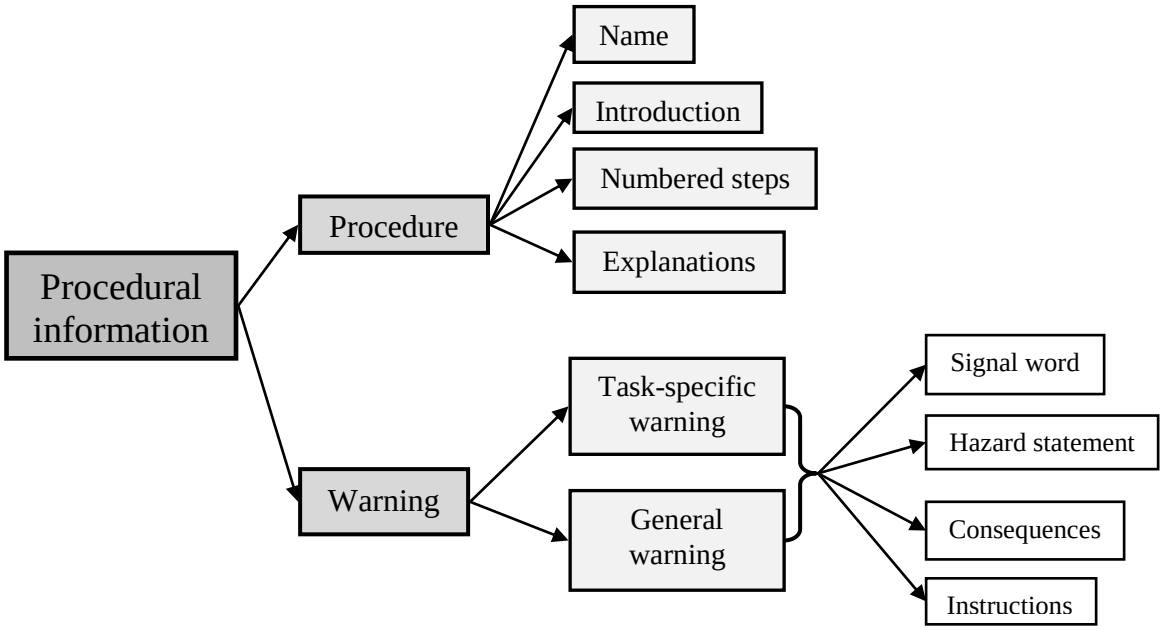


Diagram 2. Warnings as an information type.

I have positioned Warning on the same level in the hierarchy as Procedure. Warning is divided into two subtypes with regard to the amount of information they apply to: general warnings refer to the entire manual whereas task-specific warnings target one or more tasks. The former represents Horn´s idea of warnings as a subtype of Principles (see p. 11) whilst the latter is a refined version of Price and Korman's (see p. 9) procedure-related warnings.

Task-specific warnings can be embedded into procedures or they can be located in the beginning of a procedure (see p. 48), but a task-specific warning cannot be considered one of the components of a procedure. This is because warnings (general and task-specific ones alike) and procedures have different functions. The common denominator between them is that both aim to instruct the user, but their areas of specialization are divergent. On p. 8 I stated that "the purpose of procedural information is to instruct the user to perform tasks, either on a short-term or a long-term basis." At that point, I had not looked into warnings yet. The statement is no longer a comprehensive description of Procedural information; instead, it merely describes Procedure. Here is a revised description: "Procedural information is divided into two subtypes with the common purpose of instructing the user. Procedures instruct the user to perform tasks, either on a short-term or a long-term basis, whereas warnings instruct the user to avoid hazards." As regards warnings, the description applies to both subtypes. This is reflected by the above diagram: general and task-specific warnings share the same set of elements.

For the final diagram that displays warnings in relation to other information types, see Appendix B.

4. Empirical Analysis

In this section, I will introduce the materials, method and results of the empirical analysis.

4.1 Materials

In order to acquire the ten power tool manuals, I used Google to search for them from the Internet and downloaded them in PDF format. I also utilized an article on power tools I found in Wikipedia[11] in determining what kinds of products could be included. The article includes a general definition as well as a list of power tools. Furthermore, I examined a number of power tool manufacturers' web sites quite closely in order to confirm that the manuals to be downloaded were within the ISO's area of authority. Even though the ISO's full name is the *International* Organization of Standardization, its influence does not fully extend to all member countries. For instance, I was well aware that despite its ISO membership, ANSI has developed its own standard for product safety information (see p. 47 above). Therefore, manuals for power tools sold in the United States were out of the question. But I discovered that I could analyze manuals for power tools sold in any of the European Committee of Standardisation (CEN) member countries: the 27 EU countries and Croatia, Iceland, Norway and Switzerland.[12] This is because the CEN publishes ISO standards as national standards in its member countries and requires that any conflicting national standards are withdrawn.[13]

[11] Source: http://en.wikipedia.org/wiki/Power_tool.
[12] Source: http://www.cen.eu/cen/Members/Pages/default.aspx.
[13] Source: http://www.cen.eu/cen/AboutUs/Pages/default.aspx.

The results of the material gathering process are presented in the following table:

Table 2. The manufacturers, their home countries and the power tool types.

Manufacturer	Location of headquarters	Type of power tool
ABAC	Italy	Air Compressor
Black & Decker	United States	Cordless Drill
Bosch	Germany	Cordless Screwdriver
Evolution	United Kingdom	Circular Saw
Ferm	Netherlands	Belt Sander
Hitachi	Japan	Wall Chaser
Husqvarna	Sweden	Chain Saw
Rexon	Taiwan	Mitre Saw
Ryobi	Hong Kong	Rotary Hammer Drill
Worx	China	Angle Grinder

As can be seen here, all the manufacturers, the locations of their headquarters and the power tool types are different. I wanted to include as much diversity as possible within my data in order to avoid emphasizing any manufacturer or country over the others and thus to provide an overall outline of warnings in power tool manuals. There was variation in the number of pages in English (all manuals included multiple languages) which ranged from 2 to 20, but I did not think that this would lead to unequal prominence between the manuals. The number or warnings in a manual depends not only on the length of the manual but also the type of the product as well as corporate and cultural factors.

The manuals have been published between 2005 and 2010. Thus, none of the manuals is given an unfair (dis)advantage with respect to publication date. They were retrieved and downloaded from the Internet in PDF format on December 10th, 2010.

4.2 Method

The first phase of the analysis was identifying and separating all the warnings. As I stated on page 2-3 above, information type is determined by content, so I decided to take content as my starting point. My approach, then, is in conflict with the views of Laakkonen (2006, 7) who states that by *safety information* she refers specifically to "[s]eparate warnings, cautions and notes." Thus, according to her definition, "if some safety-related information is, for example, included in a descriptive paragraph but it has not been separated from the body text or visually marked as special safety information, it is not considered safety information . . ." In contrast, I carefully examined all of the textual matter in the manuals in search of warnings.

It must also be noted that I did not require the presence of all four content elements (signal word, hazard statement, consequences and instructions). A warning that contains all four elements is the ideal, but in my realistic (and perhaps somewhat cynical) view, it was not to be expected that the ideal would always be realized. It seems reasonable that if at least one element is present in a certain passage of text, that passage must be considered a warning because the manufacturer is trying to warn the user of a hazard.

Collecting all the warnings from the manuals was only the beginning. The next phase was analysing the warnings by means of a tool that I had developed for the purpose. The tool resembles a checklist that is used in technical communication for quality assessment of information products (see Hoft 1995, 291-292). It consists of 24 yes or no-questions that have been derived from the discussion in section 3 above. The hierarchical organization of the questions reflects the structure of that section. The questions operate on three levels: the whole document (D), individual warnings (W) and individual sentences (S). These abbreviations are

used in Table 3 that introduces the questions. The table is divided in three parts: 3a (content-related questions), 3b (form-related questions) and 3c (location-related questions):

Table 3a. Analysis questions regarding content (D=document-specific questions, W=warning-specific questions, S=sentence-specific questions).

Content		
Signal word		
Question	**Source(s)**	**Comment**
1. Are definitions provided for the ISO-approved signal words used? (D)	• ISO (2004, 12), p. 42	The definitions can be anywhere in the manual. My assumption is that either there are definitions for all the ISO-approved signal words in a given manual or there are no definitions at all.
2. Is the signal word CAUTION, WARNING or DANGER? (W)	• ISO (1995, 6), p. 16	If there is no signal word, the answer to both of these questions is naturally no. With lists of warnings, the minimum requirement is one signal word per list but the signal word must be suitable for each warning listed under it.
3. Is the signal word appropriate to the context? (W)	• Wogalter et al (1987, 599), p. 15	
Hazard statement and consequences		
Question	**Source(s)**	**Comment**
4. Is the cause of the hazard described? (W)	• ISO (1995, 6), p.16 • Wogalter et al (1987, 599), p. 15 • Heaps and Henley (1998, 344-346)	These questions apply to all warnings.
5. Are the consequences of non-compliance explained? (W)	• Laughery et al (1993), p.22 • Heaps and Henley (1998, 346-348), p. 22	
Instructions		
Question	**Source(s)**	**Comment**
6. Is the user told how to avoid the occurrence of the hazard? (W)	• Wogalter et al (1987, 599), p.15 • ISO (1995, 6), p.16 • Riley (2006, 296), p. 24	This question applies to all warnings.

Table 3b. Analysis questions regarding form (D=document-specific questions, W=warning-specific questions, S=sentence-specific questions).

Form		
Textual factors		
Question	**Source(s)**	**Comment**
7. Is the average sentence length max. 15 words? (W)	• Plain English Campaign (2009, 1), p. 25 • Balliro et al (2003, 30), p. 24	This question applies to all warnings. The PEC recommends 15-20 words on average and Balliro et al 15-25 words; I decided to be as strict about this as possible and limit the maximum average sentence length to 15 words.
8. Is the sentence fewer than 30 words long? (S)	• Balliro et al (2003, 30), p. 24	This question applies to all sentences.
9. Is the user addressed as *you*? (S)	• ISO (1995, 4), p. 25 • Plain English Campaign (2009, 5), p. 27	This question applies only to sentences in which the user is addressed (the imperative counts as a means of direct address). E.g. sentences with passives do not qualify.
10. Are instructions given in active voice? (S)	• ISO (1995, 4), p. 25 • Danska et al (1993, 42-3), p. 25-26 • Reep (1997, 138), p. 26 • Kemnitz (1991, 71), p. 27	Naturally, these questions apply only to sentences that contain instructions.
11. Are instructions given using the imperative or *must*/*must not*? (S)	• Huddleston and Pullum (2002, 32), p. 26-27 • Quirk et al (1985, 227), p. 27 • Quirk et al (1985, 832), p. 27 • Carter and McCarthy (2006, 654)	

(Continued on the following page.)

Visual factors		
Question	**Source(s)**	**Comment**
12. If a safety sign (excluding the general warning sign) is used, does it correspond to one of the three ISO categories (warning, prohibition or mandatory action)? (W plus any stand-alone safety signs)	• ISO (2004, 6), p. 31	This question applies to all the different types of safety signs, whether appearing in a warning or independently. The general warning sign is excluded because it should appear in each hazard severity panel and is dealt with in questions 13 and 14.
13. Are definitions provided for the ISO-approved safety signs (excluding the general warning sign) used? (D)	• ISO (2004, 11), p. 34 • Wogalter and Sojourner (1997, 540), p. 35	The definitions can be anywhere in the document.
14. Is the general warning sign used? (W)	• ISO (2004, 12), p. 41	This question applies to lists of warnings (one sign per list is required) and to individual warnings that do not belong to any list.
15. Is the meaning of the general warning sign explained? (D)	• ISO (2004, 11), p. 35-36	The explanation can be anywhere in the document.
16. Is the hazard severity panel colour yellow, orange or red? (W)	• ISO (2004, 12), p. 41 • Braun et al (1995, 185), p.44 • Manning (1997, 3), p.44	These questions apply to lists of warnings (one hazard severity panel per list is required) and to individual warnings that do not belong to any list.
17. Does the hazard severity panel colour correspond to the signal word used? (W)	• ISO (2004, 12), p. 41	
18. Is the meaning of hazard severity panel colours explained? (D)	• ISO (2004, 12), p. 41	The explanations can be anywhere in the document.
19. Are there borders around the warning? (W)	• Young (1992, 35), p. 44	This question applies to lists of warnings (one set of borders per list is required) and to individual warnings that do not belong to any list.
20. Is the signal word bolded and fully capitalized? (W)	• ISO (2004, 5), p. 30	This question applies to lists of warnings (one signal word per list is required) and to individual warnings that do not belong to any list.

(Continued on the following page.)

21. Does all of the body text formatting differ from the default formatting used in the manual? (W)	• ISO (1995, 4), p. 30	This question applies to all warnings. Any formatting option that increases salience is allowed here, except for borders for which there is a separate question. Possible means include font size, bolding, italics, colored background etc.
22. Are there borders around the warning? (W)	• Young (1992, 35), p. 44	This question applies to lists of warnings (one set of borders per list is required) and to individual warnings that do not belong to any list.
23. Is the signal word bolded and fully capitalized? (W)	• ISO (2004, 5), p. 30	This question applies to lists of warnings (one signal word per list is required) and to individual warnings that do not belong to any list.
24. Does all of the body text formatting differ from the default formatting used in the manual? (W)	• ISO (1995, 4), p. 30	This question applies to all warnings. Any formatting option that increases salience is allowed here, except for borders for which there is a separate question. Possible means include font size, bolding, italics, colored background etc.

Table 3c. Analysis questions regarding location (D=document-specific questions, W=warning-specific questions, S=sentence-specific questions).

Location		
Question	**Source(s)**	**Comment**
25. Are general warnings placed in the beginning of the manual? (W)	• Reep (1997, 72), p. 46 • Danska et al (1993, 27-8), p. 46	In order to answer these questions, I divided the individual warnings into general and task-specific warnings based on their content.
26. Are task-specific warnings located in the beginning of / just before the targeted section, paragraph or step? (W)	• Manning (1997, 3) p. 47 • Reep 1997, 208	
27. Are lists of warnings organized in a descending order of damage severity? (W)	• Danska et al (1993, 27-28), p. 46 • Reep (1997, 72), p. 46 • Vigilante and Wogalter (1997, 284), p. 46-47	Such a list comprises two or more consecutive warnings.

As the comments indicate, the range of the questions varies also within each category. Document-level questions are asked once per manual (with the exception of number 13 that concerns each ISO-approved safety sign). On the warning-level the questions can target each warning (individual warnings and warning list items), individual warnings and lists of warnings or just general warnings / task-specific warnings / lists of warnings. Number 12 is an exception because it also targets stand-alone safety signs. The sentence-level questions can be divided into three subcategories with respect to their range: all sentences (question 8); sentences in which the user is addressed (question 9); and sentences that contain instructions (questions 10 and 11). Naturally, a given sentence can be targeted by several questions: for instance, if the user is addressed in a sentence *and* it contains instructions, all four sentence-level questions are applied. Thus, there is considerable variation as to the number of cases (i.e. the number of instances to which a question applies).

4.3 Results

The results of the analysis will be introduced and discussed in this section. The number of affirmative answers to each question will be expressed as a fraction of the total number of cases. The percentage is provided only if the total number of cases is at least 100.

4.3.1 Content

All in all, 55% of the content-related cases yielded affirmative answers. Here are the percentages for the subcategories:

- Signal word: 34%
- Hazard statement and consequences: 45%

- Instructions: 92%

Instructions stand out while the other two subcategories are considerably weaker. The reasons behind these figures are discussed below.

4.3.1.1 Signal word

The results of the signal word analysis are presented in the following table:

Table 4. Analysis figures for questions 1, 2 and 3.

Question	# of affirmative answers	% of affirmative answers
1. Are definitions provided for the ISO-approved signal words used? (D)	0/10	–
2. Is the signal word CAUTION, WARNING or DANGER? (W)	85/211	40%
3. Is the signal word appropriate to the context? (W)	61/211	29%

It was rather disappointing to discover that none of the manuals included definitions for the ISO-approved signal words. Moreover, the signal word was CAUTION, WARNING or DANGER in fewer than half of the cases. There were some unofficial signal words such as ATTENTION, IMPORTANT, NOTE and PRECAUTION, but the relatively low percentage is mostly due to the fact that there was no signal word at all. The following example is from Ferm:

Always observe the safety instructions and applicable regulations.

The relatively large number of unofficial and absent signal words naturally had a negative effect on results of question 3, the appropriateness of the signal word to the context. Only official signal words have the potential to be appropriate to the context, but not all of them were successful. This was mostly due to the official signal word being followed by a long list of warnings, some of which would have required some other signal word. For instance, on the initial

pages of the Black & Decker manual, a single WARNING is followed by a list of 30 warnings. And as for single warnings, the signal words were not always ideal, either. Here is an example from Bosch:

⚠ WARNING **Do not continue to press the On/Off switch after the machine has been automatically switched off.** The battery can be damaged.

No injury is involved here, so even CAUTION would be too severe. In fact, this should not be a warning at all. On a more positive note, the choice of the signal word for the following warning from Evolution is quite impeccable:

DANGER! Keep hands away from cutting area and blade. Keep your second hand on auxiliary handle, or motor housing.

This is one of the very few appearances of DANGER in the material, which means that the authors of the manuals treated it with due respect. DANGER is supposed to be is used only when the minimum consequence of non-compliance is serious injury, and with the above warning this is most definitely the case.

4.3.1.2 Hazard statement and consequences

Here are the results concerning hazard statement and consequences:

Table 5. Analysis figures for questions 4 and 5.

Question	# of affirmative answers	% of affirmative answers
4. Is the cause of the hazard described? (W)	312/605	52%
5. Are the consequences of non-compliance explained? (W)	228/605	38%

It was an essential requirement that the cause of the hazard and the consequences of non-compliance had to be explicitly stated. This partly explains the mediocre percentages. The most common scenario was that both the cause of the hazard and consequences of non-compliance

were merely implied and therefore unsatisfactory, as illustrated by the following example from ABAC:

> Never clean the compressor with flammable liquids or solvents. Check that you have unplugged the compressor and clean with a damp cloth only.

It is fairly obvious that cleaning the compressor using flammable liquids or solvents entails a fire hazard, whereas leaving the power on while cleaning the compressor with a damp cloth naturally involves an electric hazard. Many users will probably understand these cleaning-related hazards, but they are not explicitly stated. Both sentences in the warning fall into the instructions category. Instead, in the following example from Black & Decker, both hazard statement and consequences are present, but in a very low-key capacity:

> **Do not overreach. Keep proper footing and balance at all times.** This enables better control of the power tool in unexpected situations.

The hazardous situation is brought about by the combination of overreaching - that is, improper footing and balance - and an unexpected situation. In the case of a cordless drill, the type of power tool that Black & Decker represents, the unexpected situation might occur when the drill rebounds from a wall or an object. This may result in loss of control and consequently the drill blade may hit the user's body, causing injury. Unlike the previous example, hazard statement and consequences are not buried in instructions here, but they are understated. It would be more concrete to tell the user that "*If you overreach, you may lose control of the power tool. The drill blade may hit your body and cause personal injury.*"

There were also some cases in which only one of these two elements was insufficient, but these cases were much rarer than the ones in which both elements were inadequate. In the following example from Evolution, there is no hazard statement:

WARNING! IF SAW MOTOR SHOULD STALL OR STOP BEFORE A COMPLETE CUT IS MADE ALWAYS REMOVE FROM MATERIAL BEFORE ATTEMPTING TO RESTART MOTOR. FAILURE TO DO SO COULD RESULT IN PERSONAL INJURY.

The user may be able to deduce that the possible injury would be the result of kickback, but this should definitely be made clear. In another example from Hitachi, the consequences are merely implied:

When operating a power tool outdoors, use an extension cord suitable for outdoor use.
Use of a cord suitable for outdoor use reduces the risk of electric shock.

There are two flaws in the second sentence. Firstly, it is based on likelihood (i.e. if the user obeys the instruction, she is less likely to have an electric shock), which is not an effective strategy (see p. 20); and secondly, it does not explicitly state what may happen if the user does not comply. "*If you use a cord unsuitable for outdoor use, you may have an electric shock*" would work better.

However, there were also a number of warnings in the material that successfully provided both hazard statement and consequence information. The following example from Husqvarna economically combines both elements in one short sentence:

Long-term exposure to noise can result in permanent hearing impairment. So always use approved hearing protection.

The hazard is long-term exposure to noise and the possible consequence is long-term hearing loss. It is as simple as that.

4.3.1.3 Instructions

The following table displays the results for the question regarding instructions:

Table 6. Analysis figures for question 6.

Question	# of affirmative answers	% of affirmative answers
6. Is the user told how to avoid the occurrence of the hazard? (W)	560/607	92%

Judging by the percentage of affirmative answers, the authors of the manuals seem to consider instructions the core element of warnings. As a matter of fact, there were quite a few warnings in the material in which they were the only element, as demonstrated by this example from ABAC:

Do not weld or machine the receiver. In the case of faults or rusting, replace the entire receiver

Instructions are definitely important in warnings and it was delightful to discover that the manufacturers take them seriously. However, no amount of instructional text can replace the other three elements: signal word, hazard description and consequence explanation are equally important.

4.3.2 Form

The overall percentage of form-related affirmative cases is 78%, which can be regarded as satisfactory. However, there is a substantial difference between the two subcategories:

- Textual factors: 92%
- Visual factors: 48%

A detailed explanation to these figures is provided in the discussion below.

4.3.2.1 Textual factors

The following table introduces the results of the textual factors analysis:

Table 7. Analysis figures for questions 7-11.

Question	# of affirmative answers	% of affirmative answers
7. Is the average sentence length max. 15 words? (W)	421/607	69%
8. Is the sentence less than 30 words long? (W)	1272/1301	98%
9. Is the user addressed as *you*? (S)	883/914	97%
10. Are instructions given in active voice? (S)	852/926	92%
11. Are instructions given using imperative or *must*/*must not*? (S)	853/921	93%

The average sentence length was 15 words or fewer in slightly over two thirds of the warnings, which can be regarded as satisfactory. With some warnings, it seemed that there was a deliberate attempt to keep the average sentence length under control. Here is an example from Husqvarna (average sentence length 13):

> Under no circumstances may the design of the machine be modified without the permission of the manufacturer. Always use genuine accessories. Non-authorized modifications and/or accessories can result in serious personal injury or the death of the operator or others.

The brevity of the middle sentence is the redeeming factor here. However, sometimes a single short sentence is not enough, as demonstrated by the following example from Rexon (average sentence length 18):

> Check damaged parts. Before further use of the tool, it should be carefully checked to determine that it will operate properly and perform its intended function. Check the alignment of moving parts, binding of moving parts, breakage of parts, mounting and any other conditions that may affect its operation. A guard or other part that is damaged should be property repaired or replaced by an authorized service centre unless otherwise indicated in this Instruction manual. Do not use the tool if the switch does not turn it on and off.

Here the first sentence is only three words long, but with the rest of them the length varies between 15 and 26.

As for individual sentences, I did not expect to find many instances with the word count exceeding 29. And indeed, 98% of the sentences were up to 29 words long. Here is one of the few deviant sentences from Worx (32 words):

> If a moulded plug is fitted and has to be removed take great care in disposing of the plug and severed cable, it must be destroyed to prevent engaging into a socket.

It is difficult to understand why the comma is used here instead of splitting the sentence in two.

The percentages for the rest of the textual factors were also convincing. The user was nearly always addressed as *you* (97%); instructions were usually provided in active voice (92%) and the imperative or *must*/*must not* were also widely used (93%). On a few isolated occasions, the user was addressed as *the user* or *the operator*. Incorrect verb forms were somewhat more common. Here is a sentence from Ryobi that breaks both verb rules:

> All visitors should be kept away from the work area.

Due to the use of *should*, this is more like an invitation than a command. And the illocutionary force of the sentence is reduced even further because the addressee is not identified. Complying with the instructions simply does not seem that important. "*Keep*/*You must keep*..." would be much more direct and forceful. But these are indeed minor complaints because such sentences were few and far between.

4.3.2.2 Visual factors

Here are the results for questions related to visual factors:

Table 8. Analysis figures for questions 12-21.

Question	# of affirmative answers	% of affirmative answers
12. If a safety sign (excluding the general warning sign) is used, does it correspond to one of the three ISO categories (warning, prohibition or mandatory action)? (W)	22/37	–
13. Are definitions provided for the ISO-approved safety signs (excluding the general warning sign) used? (D)	19/22	–
14. Is the general warning sign used? (W)	58/205	28%
15. Is the meaning of the general warning sign explained? (D)	3/10	–
16. Is the hazard severity panel colour yellow, orange or red? (W)	–	–
17. Does the hazard severity panel colour correspond to the signal word used? (W)	–	–
18. Is the meaning of hazard severity panel colours explained? (D)	–	–
19. Are there borders around the warning? (W)	42/204	21%
20. Is the signal word bolded and fully capitalized?	71/211	34%
21. Does all of the body text formatting differ from the default formatting used in the manual? (W)	151/607	25%

Slightly over half of the safety signs appearing in the manuals corresponded to ISO regulations. Here are a some examples of unofficial signs from Evolution, Husqvarna, Black & Decker and Ferm:

Evolution; *Wear eye protection*.

Husqvarna; *Use both hands when operating the saw*.

Black & Decker; *For indoor use only*.

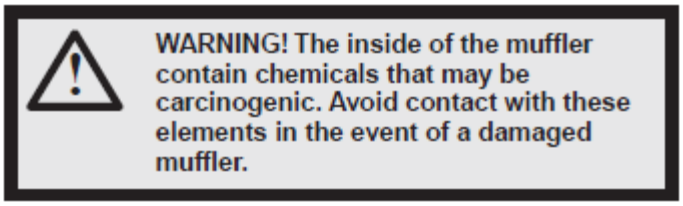
Ferm; Wear a dust mask

These are mandatory action signs, which means that they should be surrounded by a circle. All in all, there were relatively few unofficial safety signs and the official ones were nearly always accompanied by definitions.

Unfortunately, the usage of the general warning sign was less convincing: it was used in only 28 % of the cases. Moreover, merely three of the ten manuals explained its meaning.

There is not much to say about hazard severity panel colors for two reasons: firstly, there were no hazard severity panels in the material except for a few isolated instances in Bosch; and secondly, the manuals were printed entirely in black and white except for a few spots of color on the initial pages of Ferm and Husqvarna. In other words, there were no colored hazard severity panels in the material. I suppose this is because color printing is considered too expensive and the PDF versions are exact replicas of the printed black-and-white manuals. But cutting costs should not override adherence to safety standards even though the standards are voluntary. The use of colored hazard severity panels as recommended by ISO would greatly enhance the salience of warnings.

The percentages for the rest of the formatting-related questions were not very convincing. There were borders around only 21% of the warnings, the signal word was bolded and fully capitalized in 36% and all of the warning body text was saliently formatted in 28%. The following warning from Husqvarna is a rare exception in that it meets all these requirements:



This is visually the best that the material had to offer. There was a number of similarly formatted warnings in the Husqvarna manual. Unfortunately, most warnings in the material were not even close.

4.3.3 Location

55% of the cases pertaining to location were affirmative. The following table reveals the question-specific figures:

Table 9. Analysis figures for questions 22-24.

Question	# of affirmative answers	% of affirmative answers
22. Are general warnings placed in the beginning of the manual? (W)	179/192	93%
23. Are task-specific warnings located in the beginning of / just before the targeted section, paragraph or step? (W)	134/415	32%
24. Are lists of warnings organized in a descending order of damage severity? (W)	36/72	–

The majority of general warnings were correctly placed in the beginning of the manuals. However, it was quite disappointing to discover that task-specific warnings were also predominantly located on the initial pages. Here is an example of an incorrectly placed task-specific warning from Black & Decker:

- Before drilling into walls, floors or ceilings, check for the location of wiring and pipes.

This warning is clearly related to a specific task and should accompany the appropriate procedure in the section concerning usage. The following, quite similar example is from Ryobi:

- When using the electric hammer drill outdoors, connect it to an outdoor-grade extension cable type H07RN-F 2G, 1.0 mm and rain-water-protected plugs in proper working order.

Here the user is told what to do, but not how to do it. Therefore, one might assume that the connecting process is explained in a procedure to which this warning should be attached. Surprisingly, however, there is no such procedure in the user instructions. Still, the beginning of

the manual is not the right place for this task-specific warning. All in all, only one third of task-specific warnings were located in the appropriate context. In other words, the number of safety pages in the beginning of each manual was excessive. Users are unlikely to work their way through such warning clusters.

The very last question proved to be quite difficult to answer. It was often challenging to estimate and compare the damage severity of warnings, especially in the case of long lists of warnings. Roughly half of the warning lists were organized in a descending order of damage severity; this cannot be considered a very significant finding because it is perhaps the most subjective of all the observations. To exemplify the intricacies of evaluating warning lists, I will now present two short lists of warnings and comment on the choices I made. The first one, taken from Bosch, is an example of a list that is correctly organized according to damage severity:

5) **Battery tool use and care**

   a) **Recharge only with the charger specified by the manufacturer.** A charger that is suitable for one type of battery pack may create a risk of fire when used with another battery pack.

   b) **Use power tools only with specifically designated battery packs.** Use of any other battery packs may create a risk of injury and fire.

   c) **When battery pack is not in use, keep it away from other metal objects, like paper clips, coins, keys, nails, screws or other small metal objects, that can make a connection from one terminal to another.** Shorting the battery terminals together may cause burns or a fire.

   d) **Under abusive conditions, liquid may be ejected from the battery; avoid contact. If contact accidentally occurs, flush with water. If liquid contacts eyes, additionally seek medical help.** Liquid ejected from the battery may cause irritation or burns.

The hazard severity of warnings a), b) and c) is roughly the same because they all involve a fire hazard. The proper signal word all three would be WARNING, because fire could definitely result in serious injury or even death. Instead, warning d) is somewhat less forceful because battery liquid only has the potential to cause irritation or burns, i.e. minor or moderate injury. Therefore, CAUTION would be the correct signal word here. The contact of battery liquid with the eyes can naturally be more serious, but the main point of the warning is not to guard the user specifically against eye injury but against skin irritation or burns. Because the least forceful warning is placed after the three equally more powerful warnings, the sequence is correct.

The second example, this time from Black & Decker, illustrates a list that does not follow the descending pattern:

1. **Work area safety**
a. **Keep work area clean and well lit.** Cluttered or dark areas invite accidents.
b. **Do not operate power tools in explosive atmospheres, such as in the presence of flammable liquids, gases or dust.** Power tools create sparks which may ignite the dust or fumes.
c. **Keep children and bystanders away while operating a power tool.** Distractions can cause you to lose control.

At first glance, the three warnings seem equal in terms of hazard severity. In other words, they all might be regarded as "WARNING-worthy". But a closer examination reveals that warning b) is the most concrete and therefore the most striking. The hazard in question is an explosion, no more and no less. Warnings a) and c) are more vague and abstract because they attempt to account for all kinds of injuries. The consequences of non-compliance are not specified: they may be anything from minor injury to death. The differences in hazard severity are quite subtle, but

warning b) should be the first on this list because it makes the strongest impression on the user – or at least on me.

5. Conclusion

> "No warning label could have prevented evolution from creeping up on the man who electrocuted fish with household current, then waded in to collect this catch without removing the wire."
> -Wendy Northcutt in *The Darwin Awards* (2000)

The aim of this study has been twofold: to construct a theoretical model for consumer product user guide warnings as an information type and to investigate how well real-life warnings correspond to the model. As I mentioned in the introduction, the motivation to investigate warnings stems from their ever increasing importance in today's technology-laden and therefore increasingly complicated world. Consumer products are but one example of contemporary technology that is often quite complex and poses hidden hazards that users need to be warned about.

Achieving the theoretical portion of the aim consisted of three steps. Achieving the theoretical portion of the aim consisted of three steps. Firstly, a taxonomy of the existing information types in consumer product user instructions was synthesized from several theorists' views. Secondly, the ingredients of an ideal warning were drawn from a number of sources representing various fields. And thirdly, consumer product user guide warnings were integrated into the information type taxonomy.

The first step was perhaps the most challenging because the theorists had differing perspectives on information types. Combining their views to form a unified taxonomy proved quite difficult, but I am relatively satisfied with the end result. These sources mentioned warnings on very few occasions, but these instances led me to hypothesize that there were two possible positions for warnings in the taxonomy.

In contrast, the second step was quite straightforward due to the relative compatibility of the warning-related sources. They offered plenty of useful building blocks. Whenever there was any lack of consensus among the sources, I supported the views that made the most sense to me.

The third step did not bring anything new to the table, which is why I placed it in an appendix. It is a summary representing a taxonomy of information types in user instructions with warnings included, which may be considered relevant by the information design and technical communication communities.

The practical portion of the aim was achieved by means of an empirical analysis that was conducted using a specific tool derived from the theoretical model for consumer product warnings. The analysis tool resembles a checklist that is used in the technical communication industry (see p. 68) for quality control. Even though the tool was not conceived with the needs of the industry in mind and thus must be considered a side product of this study, it could be used for quality control purposes with little or no modifications. As I said in section 1.3, "[t]he theoretical information type model for warnings offers a solid foundation for warning design", and the "checklist" is derived directly from the model.

The analysis targeted the content, form and location of warnings extracted from a selection of ten power tool manuals. I hypothesized in the Introduction on the basis of previous research that the information type model for warnings would not be fully realized by actual consumer product user guide warnings. The empirical analysis provides initial corroboration to the hypothesis as certain problem areas emerged. As regards content, signal word as well as hazard statement and consequences were the weakest links; in the form category, visual factors proved to be a disappointment; and in terms of location, the placement of task-specific warnings was

substandard[14]. Thus, the results are in line with earlier material-based studies (see Wisnievski 2005; Laakkonen 2006; Yeomans 2009). Naturally, more material-based studies are needed in order to achieve a better understanding of the quality of warnings appearing in user instructions.

Since the amount of data was limited, the findings of this study must be considered preliminary. This has been merely the first step towards investigating consumer product user guide warnings as an information type. Perhaps the most important avenue for future research would be a quantitative study targeting warnings in a sufficiently large amount of manuals for as many different kinds of products as possible. By means of statistical methods, such a study would either verify or refute my initial findings. Smaller studies focusing on a specific product type would also offer valuable (dis)proof. Another possible research topic would be the use of jargon in warnings, an area I had to completely neglect due to space constraints.

In the beginning of the Introduction, I quoted a German proverb: "A man warned is half saved." It encapsulates the idea that while warnings are a significant factor in keeping people safe, their reliability is limited. Warnings deal with hazards that cannot be eliminated through design or protective guards. The avoidance of such hazards requires cooperation with an entity that cannot be trusted: the user. The quotation in the beginning of this section poignantly illustrates that even a perfect warning can be ineffective if the user completely neglects his own safety. But how could this self-destructive mindset be changed? Now that is definitely an avenue for future research.

[14] The organization of warning lists was also deficient, but as I stated in section 4.3.3 above, this finding was highly subjective.

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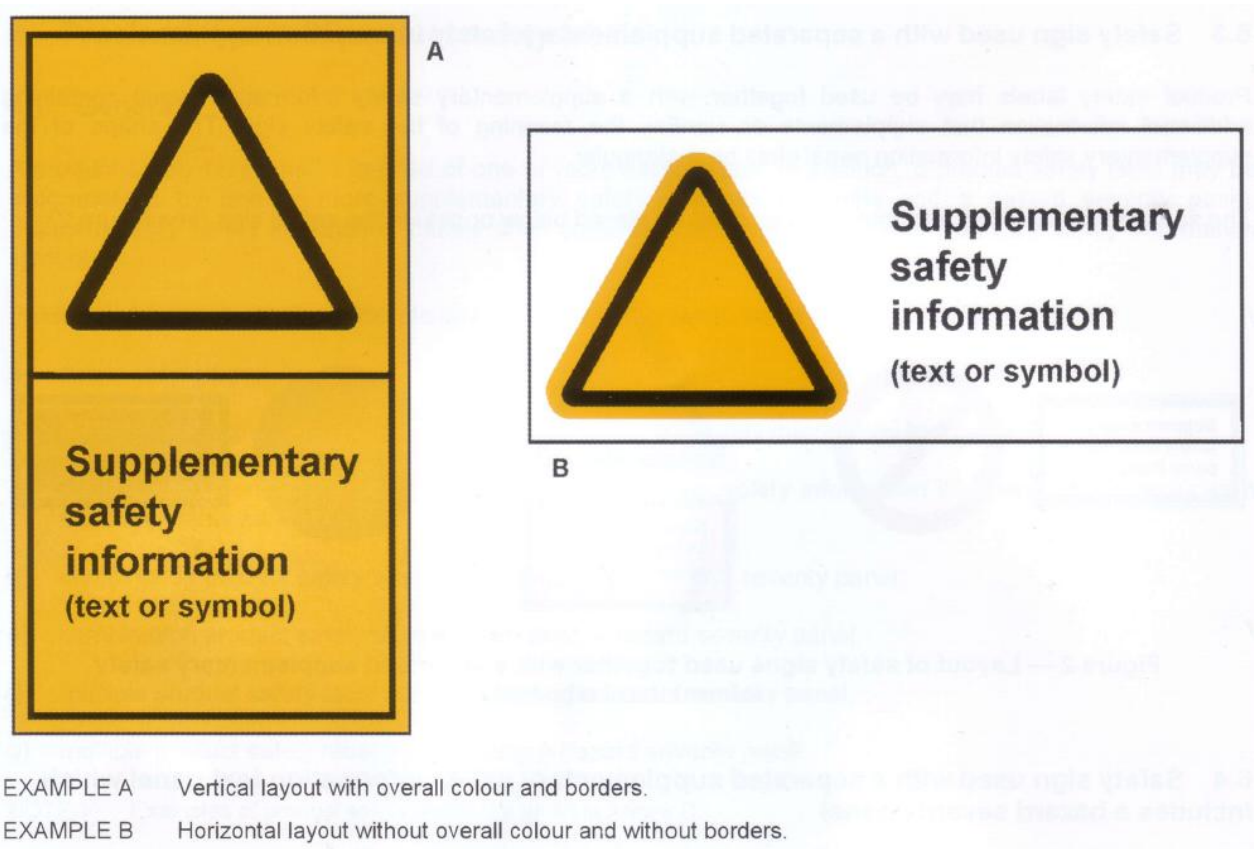
Appendix A: Illustrations of ISO product safety label types b) – g)

Figure 10. Type b): single safety sign used with a separated supplementary safety information text panel (ISO 2004, 6).

Figure 11. Type c): single safety sign used with a separated supplementary safety information text panel which includes a hazard severity panel (ISO 2004, 6).



EXAMPLE A Vertical layout with overall colour and borders.

EXAMPLE B Horizontal layout without overall colour and without borders.

Figure 12. Type d): combination product safety label not incorporating a hazard severity panel (ISO 2004, 7-8).

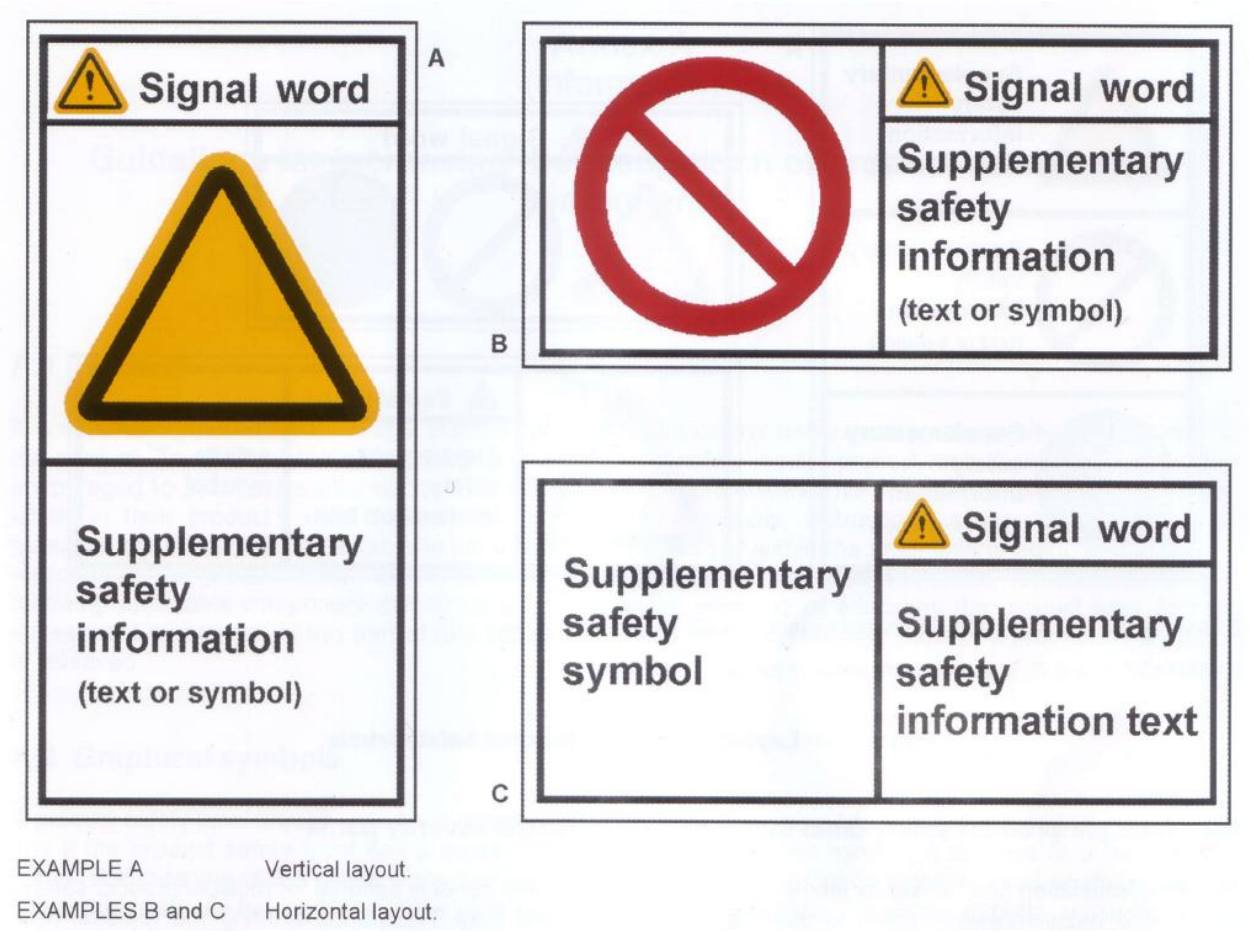


Figure 13. Type e): combination product safety label incorporating a hazard severity panel (ISO 2004, 8-9).

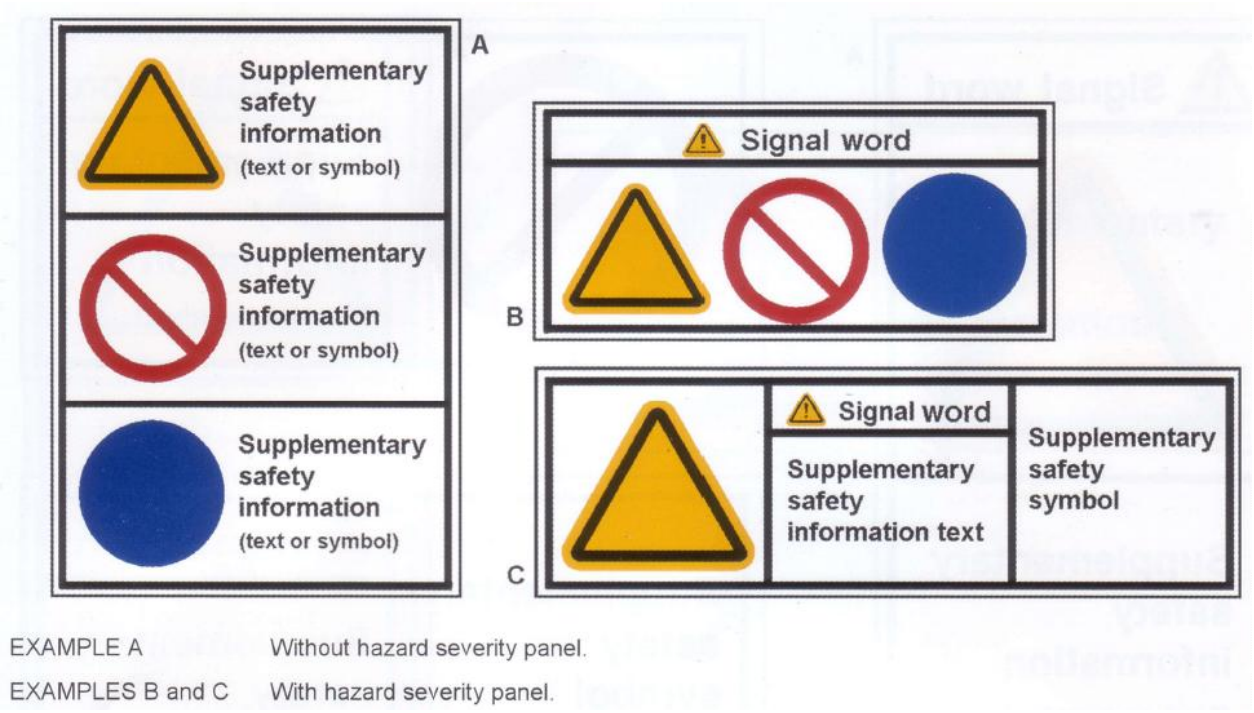


Figure 14. Types f) and g): multiple product safety label not incorporating a hazard severity panel and multiple product safety label incorporating a hazard severity panel ISO (2004, 9-10).

Appendix B. Warnings as an information type in user instructions.

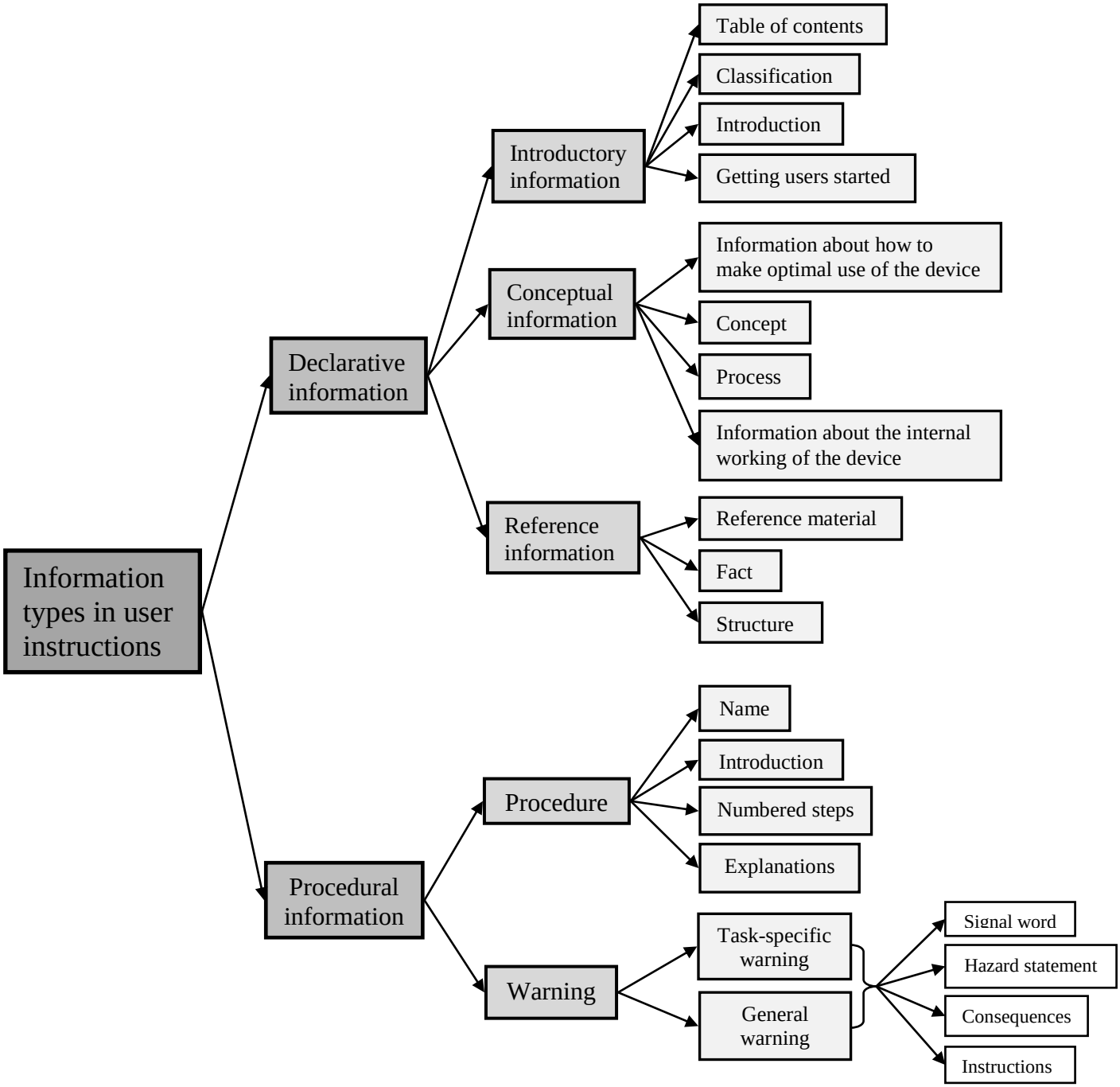


Diagram 3. Warnings as an information type in user instructions.