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THE INFLUENCE OF PICTORIALS ON EVALUATIONS OF PRESCRIPTION MEDICATION INSTRUCTIONS

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Nonverbal symbols such as pictorials are increasingly being used to convey safety-related information. Pictorials may be useful to persons who cannot read printed verbal messages because of inadequate reading skills or unfamiliarity with the language used in the message. One application for pictorials is in the depiction of safety and warning information on pharmaceutical products. The present study examined consumer preference by evaluating prescription medication instructions which differed in textual and pictorial presentation format. Results indicate that participants preferred a fully redundant (combined) text and pictorials format, rating it more effective and easier to understand and remember. The data also show a strong preference for text-only compared to pictorials-only instructions. Furthermore, there was no difference between text-only and partial pictorial (text with an incomplete set of corresponding pictorials) formats, indicating the belief that a complete absence of pictorials was just as effective as a limited set of pictorials. The results have implications for accompanying textual instructions with an incomplete set of pictorials.

Key Words: Prescription medication; Pictorials; Icons; Consumer preference; Warnings; Patient product inserts

INTRODUCTION

PRIOR TO THE MID 1980s, there was virtually no published experimental research on product warnings. Since then, research has begun to investigate how warnings influence people's knowledge and cautionary behavior. Various factors have been investigated, with an emphasis on warning effectiveness during the intermediate stages (eg, attention, comprehension, recall, etc.) of human information processing (1–4). Warning effectiveness depends on proper design of the warning itself. Correspondingly, a wide variety of warning features have been investigated, including organization, color, signal words, and explicitness (5–10). Research has involved a variety of warning types, from attachments and manuals for consumer products (11,12,13), to signs in industrial settings (14,15), to labels accompanying prescription medications (16).

Pharmaceutical Warnings

Pharmaceutical labeling has recently received increased attention (17,18, Morrow DG, Leirer VO, Andrassy JM, unpublished data, 1994 and 1995). This emphasis can be

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attributed to numerous factors, including the growing number of senior citizens in the United States population, competition between drug manufacturers, Food and Drug Administration (FDA) requirements, and in particular, the switching of prescription medications to over-the-counter status, which shifts greater responsibility for medication selection and dosing from physicians to consumers.

The effectiveness of pharmaceutical labeling is important because the hazards associated with many kinds of drugs are not commonly known to the general public. While research into the effectiveness of pharmaceutical warnings is limited, experimental evidence to date indicates that people want to be informed of the benefits and risks associated with pharmaceutical drugs (19). For prescription medications, such information has traditionally been provided by physicians, nurses, pharmacists, and other health care providers. More recently, however, medication container labels, supplementary printed information (brochures, patient product inserts, etc.), and advertising have become more common as sources of risk/benefit information. Although there are a wide variety of sources, they may nevertheless fail to convey important information to the intended target individuals due to a host of reasons. For example, the print may be too small for persons without good visual acuity, which is a particular concern for the elderly who comprise the largest group of pharmaceutical consumers. In addition, printed pharmaceutical warning messages may not be understandable to non-English speakers, or persons of a lower literacy level. These circumstances might be overcome through the use of pictorials to supplement textual warning messages.

Pictorial Warnings

Nonverbal symbols such as pictorials are increasingly being recommended as a method of conveying safety-related information (4, Morrow DG, Leirer VO, Andrassy JM, unpublished data, 1995). In fact, most warnings guidelines and standards (21,22) suggest the use of graphical symbols. Accordingly, pictorials have been designed to depict various kinds of risk information for consumer product labels (and accompanying materials), and for signs in hazardous environments.

The suggested use of pictorials is founded on the assumption, based partly on past research, that depicting information in picture form is beneficial. For example, Childers et al. (23) found that pictured information was remembered better than textual information in various consumer product advertisements. Jaynes and Boles (24) examined behavioral compliance to verbal, textual and pictorial warnings, and found the highest rates of compliance when textual warnings were combined with pictorials. Young and Wogalter (4) showed that instruction manual warnings that included both salient print and pictorial icons increased comprehension and recall. Morrell et al. (18) presented medication instructions in either a traditional text format, or in a format which combined text and pictorials. The results showed that for young adults, mixed text and pictorial instructions were comprehended and remembered better than text instructions alone.

Although several studies noted above have shown pictorials to be beneficial, other research has not always shown an advantage (25,26,27). Furthermore, Morrell et al. (18) found that for older adults, pictorials actually hindered the acquisition of medication information. Morrell concluded that participants attempted to cognitively decode the pictorials into a verbal mode, which introduced an information processing burden that lowered performance relative to younger participants.

One reason that pictorials have not always been beneficial is that many are poorly designed. In fact, several studies have shown that many commonly used pictorials are not widely understood. Laux et al. (20) tested the comprehensibility of 16 common industrial pictorials (22), and found that most of these pictorials had high levels of misinterpretations. Wolff and Wogalter (16) performed similar testing using 30 pharmaceutical pictorials published by the United States Pharmacopoeial Convention (USPC), and found

that several pictorials were comprehended at less than the 85% level recommended by the American National Standards Institute (21) for acceptable pictorials. Similarly, other researchers (28,29) have demonstrated that many common safety pictorials in use today fail to convey their intended message in comprehension tests.

Poor comprehension performance of some pictorials may in part be due to the concept being depicted. In general, it appears that misinterpreted pictorials tend to represent abstract, less visible ideas (eg, the passage of time), while better designed and understood pictorials tend to represent more concrete, or visible concepts (eg, no smoking). If pictorials are designed well and the concepts to be represented are not overly complex, however, the research suggests that pictorials can aid comprehension and recall (30–33).

INFORMATION PROCESSING THEORY

In a literature review, Levin and Lesgold (34) summarized approximately 20 experiments on picture-text learning, and describe the effects of supplementing text with pictures as being "positive, potent, and pervasive." Levin (35) suggests that combining pictures with text results in the following positive functions:

1. Motivation—pictures may have a motivating effect, serving to increase interest in the text, thereby increasing the likelihood that the text will be read carefully,
2. Reiteration—pictures may repeat the information presented in the text, providing additional exposure (redundancy) to the textual concept. Levin describes this as the "two exposures are better than one" concept,
3. Organization—pictures may help to organize the content of the text into meaningful groupings,
4. Interpretation—pictures may serve to make relatively abstract or difficult concepts more understandable,
5. Transformation—pictures are in a form which facilitate long-term memory, and
6. Representation—pictures make the material more specific, and provide a second modality through which the text information can be cognitively represented.

The transformation and representation functions have received empirical support, and are best summarized by Paivio's Dual Code Theory.

According to Dual Code Theory, text and pictures result in two different kinds of conceptual representations (or codes) in memory. Paivio (36) theorizes that humans have a verbal system specialized for processing and storing linguistic (textual) information and a separate nonverbal system which processes spatial and mental imagery (eg, pictures). The two systems can function independently but are also interconnected. Independence implies that the two systems can be separately accessed by relevant stimuli; the imagery system is activated more directly by perceptual objects or pictures, and the verbal system is activated more readily by words or linguistic stimuli. Interconnectedness implies that nonverbal information can be transformed into verbal information, or vice versa.

The critical aspect of Dual Code Theory is that representing information in both a pictured format and a textual format assures that the information will be encoded and stored in two separate processing systems. Consequently, the stored information can be activated by either nonverbal or verbal stimuli, thereby increasing the probability of successful retrieval. In a dual-coded format, information gleaned from text may activate (augment) information gleaned from a pictorial, and vice versa.

A similar theory has been proposed by Wickens (37) who contends that using both a textual and pictorial code provides a means of redundant coding, where different formats emphasize different properties of the information. Depending on the task at hand, either the spatial information depicted in pictorials or the semantic relationships found in verbal

information may be more relevant. In addition, communicating via redundant pictorial/text combinations facilitates information processing by promoting flexibility, thereby enabling people to capitalize on the information extraction method (spatial pictures or semantic language) they process best. Wickens further believes that pictorials provide an overall context or "frame" within which words can be used to elaborate critical details of the pictured concept. Overall, this redundancy results in the most efficient processing of information, with redundant picture/word combinations resulting in superior response speed, accuracy, and recall, than either words or pictures alone.

Pharmaceutical Pictorials

As noted earlier, pictorials are beginning to be used more often on the printed materials that frequently accompany prescription medications. Unfortunately, many medication instructions are often complex concepts that have multiple components. Consider the instruction "take two hours after meals." This is an abstract, multiple-component concept involving time and drug dosing relative to food intake. As previously discussed, abstract concepts are not easily represented by pictorials. In fact, this instruction is currently represented by a USPC pictorial which Magurno et al. (29) found to be poorly understood.

Poor comprehension can sometimes lead to "critical confusions," where people understand the opposite of what they should, leading to incorrect (and potentially dangerous) behavior. Wogalter (38) cites an example of critical confusion involving a pictorial designed for an acne drug which causes birth defects in babies of women taking the drug during pregnancy. The acne drug pictorial shows a side-view outline shape of a pregnant woman within a circle-slash negation sign. The intended meaning of the pictorial is that women should not take the drug if they are pregnant. Some women, however, incorrectly interpreted the pictorial to mean that the drug might help in preventing pregnancy!

Practical Implications

Pharmaceutical manufacturers recognize the need to avoid using poorly comprehended pictorials which do not adequately convey the intended message. Because pictorials for some concepts may not show adequate comprehension, and may also have unduly high critical confusion rates, pictorials for certain important information may not be available. Thus, the printed material accompanying prescription medications may only include an incomplete set of pictorials, that is, each and every textual instruction item may not have an accompanying pictorial since the more abstract (complex) information is likely to lack pictorial representation. For example, a medication information pamphlet containing 10 printed pharmaceutical instructions might have four concrete (simple) instructions accompanied by pictorials, while the six more abstract (complex) instructions may not.

A potential problem in using a partial set of pictorials to accompany textual instructions is that people might overlook (not attend) those printed instructions which do not have an associated pictorial. Laughery et al. (39) found that pictorials can substantially improve noticeability, and serve to "reach out and grab people's attention." Similarly, Schmidt and Kysor (40) describe some pictorials as being both attention-getting and attention-holding, and Young and Wogalter (4) state that pictorials attract attention and increase a warning's noticeability. Together, this suggests that people may readily attend to instructions accompanied by pictorials, but this may occur at the expense of the instructions appearing only as text. In other words, attention may be drawn to the instructions accompanied by pictorials, and people may not look at the material without pictorials. People may also judge instructions without pictorials as less important, thereby choosing not to read them.

In fact, Paivio's (36) and Wickens' (37)

theoretical work suggest that although dual (redundant) coding can be beneficial, it may not always result in facilitative effects. As people readily attend to dual-coded instructions (text accompanied by pictorials), this processing may take place at the expense of single-coded instructions (eg, text only). As a consequence, little or no attention may be devoted to reading the text only instructions. This implies that an incomplete set of pictorials may degrade information acquisition in some cases (producing more of a drawback than a benefit).

The current research evaluated the effectiveness of pharmaceutical instructions which differed in textual and pictorial presentation. Subjective preference ratings were collected for instructions that were presented in different pictorial/text formats.

METHODS AND MATERIALS

Materials

Five different instruction sheets for a fictitious drug were created. Each sheet contained the same eight medication instructions that specified the directions and warnings for drug use. The instruction sheets were:

1. Text-only,
2. Pictorials-only,
3. Text with all pictorials,
4. Partial pictorials, and
5. No instructions.

Participants were randomly assigned to one of the five conditions.

The instruction sheets were modeled after those supplied by various pharmaceutical supply companies and drug manufacturers. A fictitious drug was used to assure that participants had no prior knowledge or experience with the medication. The drug name and purpose (also fictitious) were printed on the top of each instruction sheet followed by eight common medication instructions such as: do not take with milk or dairy products, store in refrigerator, and so forth. The text instructions were printed in list format with associated pictorials located to the left of the corresponding text.

In the text with all pictorials format (shown in Figure 1), completely redundant text and pictorials were shown for each instruction item. In the text-only format, the pictorials were not shown, and in the pictorials-only format, the text was not shown. In the partial pictorials format, two versions of the drug information sheet were created with half of the instructions having an associated pictorial. The first partial pictorials sheet included pictorials for instructions 1,3,4, and 7, while the second partial pictorials sheet included pictorials for instructions 2,5,6, and 8. Participants in this condition were randomly assigned to one of the two partial pictorials sheets (half to each sheet), and their ratings were combined and analyzed together. The no instructions format served as a control condition, and contained only the drug name and purpose.

The drug information sheets were on standard 21.6 cm (8.5 inches) × 27.9 cm (11.0 inches) white bond paper with information on one side. Text was printed in 12-point Times, and pictorials were approximately 1.9 cm^2 (.75 $inches^2$). Pictorials were taken from a larger set developed for the USPC that have been tested to have comprehension levels of at least 85% (16,21,29).

Procedure

The experimenter initially read a scenario, explaining to each participant that he or she had been diagnosed with a medical condition requiring treatment by a prescription medication. Participants were then handed a plastic prescription medication container with a label containing the prescribing doctor's name, pharmacy name, and basic dosage instructions. Participants were asked to look at the bottle as if it were handed to them by an actual pharmacist. The set of five drug information sheets were then displayed in one of five orders according to a balanced Latin Square. Participants were asked to read the information contained on the sheets, and to familiarize themselves with the different pre-

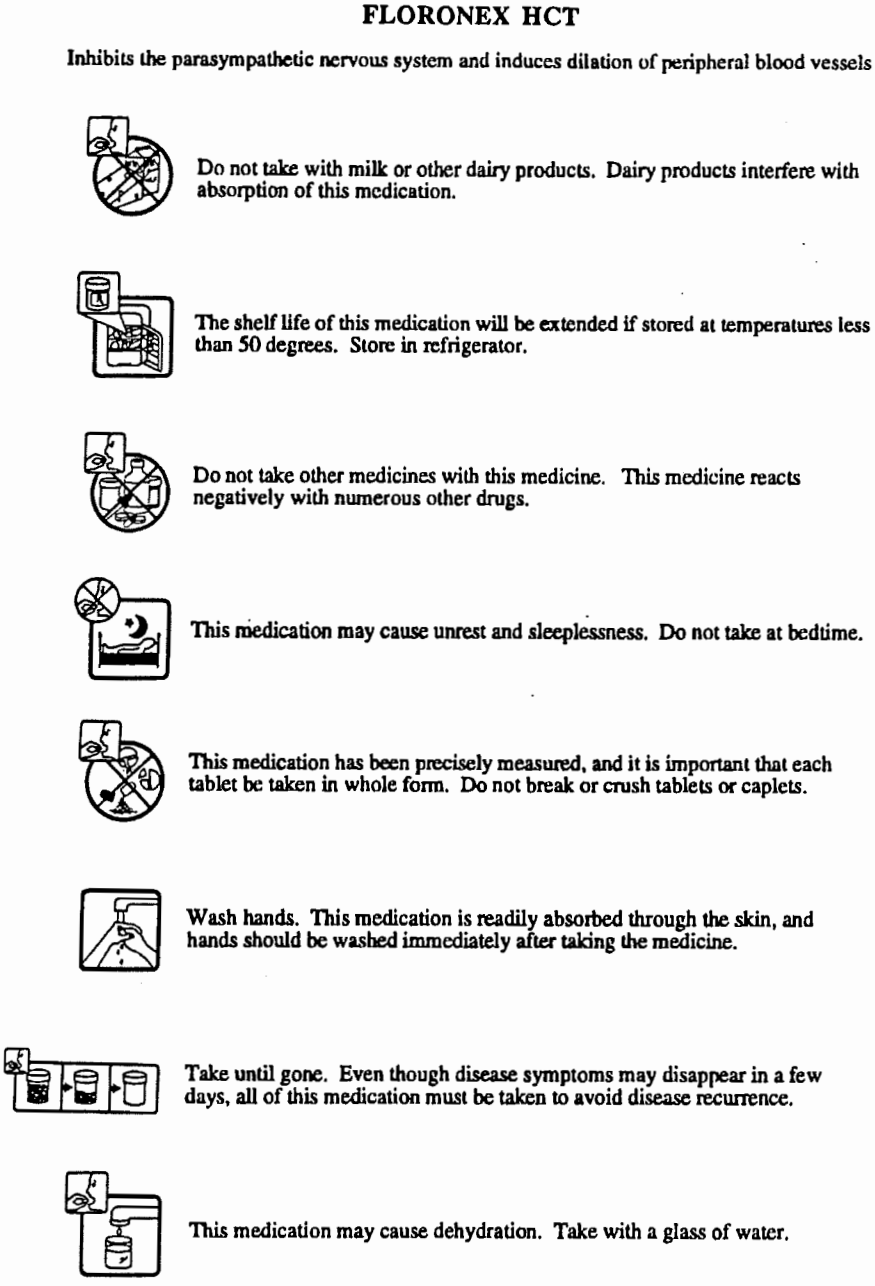

FIGURE 1. Instruction sheet containing text with all pictorials.

sentation formats. Participants were then asked to rate each sheet using eight-point verbally-anchored Likert scales on the following questions:

1. **Ease of Reading**—How easy is it to read the instructions on the drug information sheet (1 = Extremely Difficult, 8 = Extremely Easy)?
2. **Ease of Understanding**—How easy is it to understand the instructions on the drug information sheet (1 = Extremely Difficult, 8 = Extremely Easy)?
3. **Overall Effectiveness**—How effective is

the drug information sheet in conveying all of the medication instructions (1 = Extremely Ineffective, 8 = Extremely Effective)?

4. **Likelihood of Reading**—If you were obtaining medication from an actual pharmacy, how likely is it that you would read the instructions found on a similar drug information sheet (1 = Extremely Unlikely, 8 = Extremely Likely)? and
5. **Overall Preference**—Overall, how much do you like the drug information sheet (1 = Extremely Dislike, 8 = Extremely Like)?

Two additional questions applied only to those sheets containing pictorials:

6. **Pictorial Understanding**—How effective are the pictorials in helping you understand all of the instructions (1 = Extremely Ineffective, 8 = Extremely Effective)? and
7. **Pictorials Memory**—How effective are the pictorials in helping you remember all of the instructions (1 = Extremely Ineffective, 8 = Extremely Effective)?

Participants

Thirty-five males and females participated, ranging in age from 18–59. All were enrolled in undergraduate psychology courses at North Carolina State University, and they received course credit for participation.

RESULTS

Cell means and standard deviations for all conditions can be seen in Table 1. Participants' ratings for each of the preference dimensions were analyzed using separate one-way repeated measures analyses of variance (ANOVAs).

All of the ANOVAs performed on the measures showed a significant effect for the type of instruction sheet $F(4,136) = 56.26$, 124.50, 194.40, 30.50, and 188.39, $ps <$ .0001 for ease of reading, ease of understanding, effectiveness of instructions, likelihood of reading, and overall preference, respectively. For the instruction sheets which contained pictorials, the ANOVAs showed a significant effect for the type of instruction sheet, $F(2,68) = 110.66$, and 43.53, $ps <$ .0001 for effectiveness of pictorials in aiding understanding, and effectiveness of pictorials in aiding memory, respectively. Across all measures, text with all pictorials was consistently rated the highest, with partial pictorials and text-only next highest, followed by pictorials-only, with no instructions rated the lowest. Comparisons among the means using Fisher's Least Significant Difference (LSD) test ($ps < .05$) showed that text with all pictorials was rated significantly higher than the other formats on all measures except for the ease of understanding ratings, where there was no difference with the partial pictorials condition, and the likelihood of reading ratings, where there was no difference with the text-only and partial pictorials conditions. Fisher's LSD showed that all other comparisons were significant ($ps < .05$) except those between text-only and partial pictorials, which did not exhibit significant differences using any measure.

DISCUSSION

This experiment demonstrated that participants showed a greater preference for medication instruction sheets that included textual instructions accompanied by a full set of pictorials. Participants judged the instructions with a complete set of pictorials easier to read, more effective, and preferred overall. Furthermore, the pictorials in these instructions were seen as aiding understanding and memory more effectively than the other pictorial formats. Overall, this is consistent with other research findings showing that people prefer textual medication instructions accompanied by pictorials (19). These findings are also consistent with Paivio's (36) and Wickens' (37) theoretical work, but also extends this work by showing that dual coding principles apply to subjective preferences.

Another finding of interest involves the single-coded instructions. Across all dimensions, the data show a strong preference for the text-only instructions compared to the pictorials-only instructions. Textual benefits may be attributed to several factors, including the fact that the words may have been more specific than the pictorials. This is con-

TABLE 1
Mean Preference Ratings and Standard Deviations (in Parentheses) Per Instruction Sheet Condition

	Preference Dimensions						
Condition	Ease of Understanding	Ease of Reading	Overall Effectiveness	Likelihood of Reading	Overall Preference	Pictorial Understanding	Pictorial Memory
Text With All Pictorials	7.09 (0.89)	7.29 (0.79)	7.31 (0.72)	6.69 (0.72)	7.51 (0.66)	6.86 (1.31)	6.77 (1.46)
Partial Pictorials	6.49 (1.01)	6.34 (1.21)	6.00 (1.21)	6.29 (1.34)	5.66 (1.21)	5.89 (1.37)	5.77 (1.46)
Text Only	6.34 (1.17)	6.29 (1.05)	5.86 (1.06)	6.29 (1.34)	5.43 (1.15)	N/A*	N/A*
Pictorials Only	3.89 (1.70)	3.77 (1.11)	3.71 (1.47)	4.71 (2.04)	3.31 (1.37)	4.51 (1.38)	4.54 (1.70)
No Instructions	3.20 (2.28)	2.20 (1.49)	1.23 (0.55)	3.43 (2.60)	1.26 (0.61)	N/A*	N/A*

*Pictorials were not shown in the Text Only and No Instructions sheets, therefore pictorial questions were excluded.

sistent with Wickens' (37) belief that humans use words to elaborate the details of pictured concepts. Another benefit may have been that the words used in the text were more understandable to some participants. Although the pictorials were chosen to have high comprehension rates, the meaning of some pictorials may still have been unclear to some individuals.

Nevertheless, pictorials alone were judged to be of some benefit. When compared to the no instruction (control) group, the pictorials alone group received higher ratings on all dimensions, indicating participants' beliefs that even pictorials which had no textual explanation were preferred over an absence of instructions.

Of perhaps greatest interest is the medication instructions which contained only a partial set of pictorials. While the partial pictorial format was preferred to the pictorial-only and no instruction (control) formats, there was no significant difference between the partial pictorial format and the format containing text-only. It appears that people took the attitude that if a pictorial does not accompany each and every item of instruction, then an incomplete set of pictorials has little to offer above and beyond text used alone. This finding may be important to the pharmaceutical industry, where partial sets of pictorials are often used to communicate medication information.

This study suggests a need for further research on issues related to dual-coded instructions versus partially dual-coded (partial pictorial) instructions. While subjective preference ratings are necessary and valuable, objective performance measures which assess attention, comprehension, memory, and behavioral compliance are also needed. Various information processing theories predict that dual coded instructions will not only be preferred, but will also result in higher comprehension and retrieval. Theory also predicts that dual-coding in partial pictorial formats could degrade performance, since text instructions without an accompanying pictorial may be overlooked or inefficiently processed.

An additional area of study involves the need to perform testing on noncollege student participant groups. Since pictorials have been proposed as an aid to people who have difficulty reading textual instructions, additional testing with individuals of a lower literacy level, or with those unfamiliar with the English language, should be performed. Research using the elderly is especially needed, since senior citizens often have declining physical and mental abilities, and proportionally tend to consume the greatest amount of prescription medications. While the use of pictorials to augment textual medication instructions holds great promise, the implications regarding consumer preferences, compliance, and safe behavior require further investigation.

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