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The use of pictorials to communicate safety-related information has been widely offered as a way of reaching diverse users owing to the pictorials' assumed universal information transmission potential. The present study examined comprehensibility of a set of safety pictorials, and then employed a training procedure (providing short verbal descriptions of the pictorials) to enhance comprehension and retention. Comprehension was tested for all participants prior to training, and after 1 week. Additionally, comprehension was also tested for some participants immediately following training, and 6 months after training. Also manipulated was the content of instruction (supplying either the pictorial's associated verbal label or verbal label plus a more detailed explanatory statement), and difficulty level ('easy' versus 'difficult' to understand pictorials, as determined by prior research). The results showed that training led to a significant increase in pictorial comprehension. Easy pictorials were comprehended (both initially and following training) better than difficult pictorials, with the latter showing a more dramatic improvement in comprehension following training. Post-training pictorial comprehension was also relatively stable over time. The additional explanatory content statement had no effect on comprehension and recall. The substantial gains in understanding the more difficult pictorials suggest that brief training can substantially facilitate comprehension for pictorials that would otherwise not be readily understood.

1. Introduction

Non-verbal symbols such as pictorials are increasingly being recommended and used to convey warnings, risk communication, and safety-related information (Laux *et al.* 1989, Young and Wogalter 1990). Most warnings guidelines and standards recommend the use of graphical symbols (FMC 1985, Westinghouse 1981, ISO 1984, 1988, ANSI 1991). Accordingly, pictorials have been designed to depict various kinds of hazard-related information in industrial settings, by health care providers, and on consumer products.

The increasingly widespread use of pictorials is based on the assumed beneficial nature of depicting messages in picture form. Research suggests that pictorials can be useful in conveying information (Childers *et al.* 1986, Young and Wogalter 1990). Benefits arise partly because well-designed pictorials can quickly communicate concepts and instructions at a glance. Pictorials may also be useful to persons who can not read printed verbal messages because of vision problems, inadequate reading skills, or unfamiliarity with the language used in the message (e.g. children, the elderly, foreign visitors, or the illiterate) (Wogalter and Silver 1995, Kalsher *et al.* 1996). As concerns for diverse language and comprehension abilities increase with multi-national markets, more companies appear to be considering the use of pictorials to cross language barriers.

Although several studies have shown benefits of using pictorials, empirical evidence has not always demonstrated a clear advantage associated with pictorial use. Friedmann (1988) found no effect of pictorials on warning compliance. Otsubo (1988) failed to show that pictographs did not influence people's reading, complying, noticing, comprehending, or recalling warning information. Morrell *et al.* (1990) found that, for older adults, pharmaceutical pictorials hindered the acquisition of information. Morrell concluded that participants cognitively translated the pictorials into verbal instructions, introducing an information processing burden on older participants that lowered performance relative to younger participants.

One reason that pictorials have not always lived up to their billing is that they frequently fail to convey their intended message. Several studies (Collins *et al.* 1982, Laux *et al.* 1989, Wolff and Wogalter 1993) have shown that many pictorials in use today are not widely understood. The better understood pictorials tend to be of more concrete concepts (e.g. no smoking), whereas the less well understood concepts tend to involve abstract ideas (e.g. the passage of time).

Indeed, some concepts may never be adequately communicated via simple pictorials. Wolff and Wogalter (1993) and Magurno *et al.* (1994) describe a set of studies in which pharmaceutical pictorials were iteratively evaluated across a series of test and redesign cycles. Even after several iterations, pictorials of some concepts never reached the ANSI criteria of 85% correct comprehension.

The dilemma then becomes what to do when it is not possible (or practical) to design a readily understandable pictorial for a particular concept. One possibility is to train people on the meanings of various pictorials (Green and Pew 1978, Cairney and Sless 1982). Effective training should not only facilitate understanding in the short term but should also ensure comprehension in the long term. In addition, a practical concern is that the training should be simple and brief to keep costs low in terms of resources, time and money.

One training method that fits the above criteria is to simply expose individuals to pictorials with their associated written verbal descriptions. Wickens (1992) suggests that communicating via pictorial/text combinations facilitates information processing by promoting flexibility, thereby enabling people to capitalize on the information extraction method (spatial pictures or semantic language) that they process best. Wickens further believes that pictorials provide an overall context or 'frame' within which words can be used to fill in critical details of the pictured concept. Wiseman *et al.* (1985) refer to this as processing elaboration. To Wiseman *et al.* (1985) concept memory is enhanced by the combined processing of words and pictures, and memory quality is improved as the details of pictures and words synthesize.

When combining text and pictorials, researchers have suggested that concept memory will be enhanced even further as additional detail is provided by the textual description (Paivio 1975, D'Agostino *et al.* 1977). In general, greater textual detail provides additional information that may not be readily apparent in either pictured concepts or less-detailed simple text. When applied to warnings, the greater detail may supply information and thus facilitate memory for critical concepts such as hazard severity, explicitness, or consequences.

The purpose of the present research was to assess the effect of training on the comprehension and retention of safety pictorials over time. Forty industrial-safety and pharmaceutical pictorials were categorized using data from previous research (Collins *et al.* 1982, Frascara and Yau 1986, Magurno *et al.* 1994) as either easy to understand (high levels of comprehension) or difficult to understand (low levels of comprehension). Pictorial comprehension was then initially measured to determine baseline levels of comprehension and to confirm categorization.

Training was then provided which supplied (a) a simple verbal label for each pictorial, or (b) the simple verbal label plus an explanatory statement providing additional message detail. The purpose of this manipulation was to determine the effect of providing additional elaborative verbal detail. As stated above, the information processing literature predicts that greater detail should facilitate performance on subsequent pictorial comprehension tests.

To determine training effectiveness, comprehension tests were administered at numerous intervals. The first test (pre-training test) was administered prior to training, and assessed participants' pre-training comprehension level. A subsequent test (immediate post-training test) was taken by one-half of the participants immediately following training. The presence versus absence of this test served to determine its potential influence on the outcome of subsequent tests. Other tests included a 1-week post-training test, administered to all participants 1 week after training, and a 6-month post-training test, taken by a small subset of participants 6 months after training. Manipulating the testing intervals served to determine both training usefulness and extent to which effects were maintained over time.

While the verbal memory literature predicts that unrehearsed information rapidly decays, there are reasons to believe that pictorial memory might react differently. First, research using other forms of complex visual stimuli (e.g. faces) shows resistance to memory decay over time (Laughery and Wogalter 1989). Second, two types of stimuli — one for language (text) and another for visual spatial (pictorial) processing — may utilize two coding systems involving both brain hemispheres (as opposed to just one used by single-coded textual information) (Wickens 1992). Using both hemispheres via dual coding should promote greater memory structure with enhanced resilience over time (Paivio 1975).

2. Method

2.1. *Design*

Five factors were manipulated. Two were between-subjects variables: (a) content of instruction (verbal label only versus verbal label with explanatory statement), and (b) immediate post-training test (presence versus absence). The crossing of these two produced four groups. The other three factors were repeated-measures variables: (a) pictorial type (industrial-safety and pharmaceutical pictorials), (b) difficulty level (easy and difficult to understand pictorials, as determined by prior research), and (c) time of testing (pre-training, immediately following training, after a 1-week delay, and after 6 months). The dependent variable was comprehension test scores.

Since the immediate post-training test was administered to only half of the participants, the experiment was an incomplete factorial design, and multiple ANOVAs were needed for analysis. The first ANOVA included all participants but did not include data from the immediate post-training test. The resultant 5 factor mixed-model ANOVA included the factors: (a) content of instruction: verbal label only versus verbal label plus explanation, (b) immediate test: having or not having an immediate post-training test, (c) time of test: pre-training versus 1-week post-training, (d) pictorial type: industrial-safety versus pharmaceutical pictorials, and (e) difficulty level: easy versus difficult to understand pictorials.

The second ANOVA included scores from the intermediate post-training test, and therefore excluded participants who did not take this test. The resultant 4-factor mixed-model ANOVA included the factors: (a) content of instruction: verbal label only versus verbal label plus explanation, (b) time of test (with three levels as opposed to the first ANOVA, which had two levels for this factor): pre-training versus immediate post-training versus 1-week post-training, (c) pictorial type: industrial-safety versus pharmaceutical pictorials, and (d) difficulty level: easy versus difficult to understand pictorials.

A final analysis (using a subset of participants) was conducted using the 6-months post-training test data. A 3-way within-subjects ANOVA included the factors: (a) time of test: pre-training versus 1-week post-training versus 6-month post-training, (b) pictorial type: industrial-safety versus pharmaceutical pictorials, and (c) difficulty level: easy versus difficult to understand pictorials.

2.2. *Participants*

Sixty North Carolina State University undergraduates participated for research credits in introductory psychology courses. Fifteen participants were randomly assigned to each of the four between-subjects groups.

2.3. *Materials*

Forty pre-existing safety-related pictorials were used. Twenty were selected from a set of industrial-safety pictorials used to convey various environmental hazards and precautions, and 20 were selected from a set of pharmaceutical pictorials used to communicate medical (safety-related) instructions. Two sets (types) of pictorials were used in order to determine the extent that effects could be generalized across pictorial categories. Within each set, 10 pictorials were classified as easy to comprehend and 10 were classified as difficult to comprehend (table 1). Selection and classification were based on comprehension tests of industrial-safety pictorials (Westinghouse 1981, FMC 1985) by Collins *et al.* (1982), Frascara and Yau (1986), and Mayer (1992), and of pharmaceutical pictorials by Wolff and Wogalter (1993) and Magurno *et al.* (1994).

Examples of each of the four types of pictorials (easy industrial-safety, difficult industrial-safety, easy pharmaceutical, and difficult pharmaceutical) are shown in figure 1.

The 40 pictorials were printed on individual $10{\cdot}2 \times 15{\cdot}2$ cm sheets of white paper. The pictorial sheets were randomized for each participant and clipped together as a booklet. In the training sessions, overhead projection transparencies were used to show the pictorials and associated text. Example pictorials with associated verbal labels and explanatory statements are shown in figure 2. Verbal labels were obtained from published documentation accompanying the pictorials, and explanatory statements were derived from interviews with subject matter experts (e.g. pharmacists and chemical engineers). Numbered and lined response sheets were used by participants to record answers to the comprehension tests.

Table 1. Pictorials used.

Industrial-safety	Pharmaceutical
Easy	*Easy*
Danger! Fork lift	Do not take if pregnant
Explosive	Wash hands
Fumes	Do not take if breast-feeding
Hot surface	Store in refrigerator
Electrical hazard	Do not take with dairy products
Danger of slipping	Take 4 times a day
Danger! Poison	Shake well
Danger! Entanglement hazard	Keep medicine out of reach of children
No open flames	Take with water
First aid	Do not take alcohol
Difficult	*Difficult*
Foot protection required	Do not store in sunlight
Use stairs in case of fire	Do not break or crush tablets
Respiratory protection required	This medicine may make you drowsy
Emergency exit	Do not take other medications with this medication
Biohazard	Take until gone
Noise hazard	Take at bedtime
Corrosion hazard	Take 1 hour after meals
Danger! Flammable	If you have questions, call this number
Falling objects	Do not take with food
Laser	Take 1 hour before meals

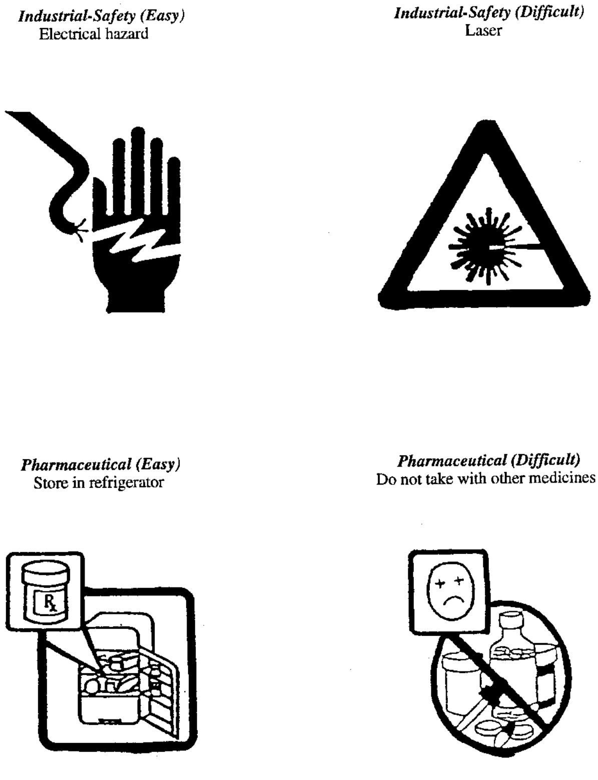


Figure 1. Example of easy and difficult pharmaceutical and industrial-safety pictorials.

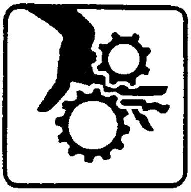
2.4. *Procedure*
Testing and training sessions began with the pre-training test, where participants were asked to write down the meaning of the concepts represented by the 40 pictorials. Participants were provided with as much time as was needed to write down their responses.

Following the pre-training test, all participants received one of two types of pictorial training. Half of the participants viewed the set of 40 pictorials along with the descriptive verbal labels printed below each pictorial, and half of the participants viewed the 40 pictorials with the verbal label plus a short statement explaining the nature of the concept or hazard. These materials were shown to participants via overhead transparencies. As each overhead transparency was presented, the experimenter read aloud the associated verbal statements (either the label alone or the label plus explanation). The experimenter paused for approximately 3 s after saying each statement before presenting the next pictorial.

After the training session, participants engaged in a set of filler tasks that inserted a non-rehearsal distracter activity and prevented stimuli from being retained in short-term memory. The filler tasks lasted approximately 10 min and consisted of two perceptual speed (letter search) tasks and a demographic questionnaire.

One half of the participants were released after the filler tasks with the understanding that they would return 7 days later to receive full credit for their

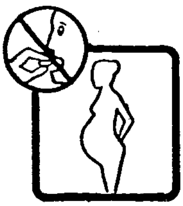
Industrial-Safety



Verbal Label: Danger! Entanglement Hazard: Keep Hands Clear

Explanatory Statement: Wearing loose clothing and/or jewelry can cause entanglement to occur, resulting in loss of limbs or death. Long hair should be tied back to avoid entanglement.

Pharmaceutical



Verbal Label: Do Not Take if Pregnant

Explanatory Statement: Medications are passed to the baby from the mother and may affect or hurt the baby. Effects can include substantial birth defects, stillbirths, or spontaneous abortions.

Figure 2. Example of pictorials with corresponding verbal labels and explanatory statements.

research participation. The remaining participants took another comprehension test (immediate post-training test) on the same set of 40 pictorials. In the same manner as the pre-training test, participants taking the immediate post-training test were shown the pictorials (in new random orders) and were asked to write down their meaning. After completing the test, participants were released with the understanding that they would return in 7 days to receive full credit for their research participation.

Approximately 1 week later, all participants returned to take the 7-day post-training test. Testing procedures were identical to those in earlier phases, with the pictorials presented in new random orders. Participants were then debriefed, given research credit, and thanked.

Six months later, attempts were made to contact all participants in order to arrange a 6-month post-training test. However, many of the students could not be contacted or did not show up (many had moved away from the Raleigh area, some no longer had valid telephone numbers, contact was attempted during exam week before the summer vacation, etc.). Consequently, only 15 of the original 60 participants took the 6-month post-training test. This test was identical to previous comprehension tests.

3. Results

Two scoring procedures were employed. In the first procedure, participants' responses were scored with a '1' if correct and '0' if incorrect. Correct responses had to be synonymous with the description provided in the explanatory statement. Analyses indicated that performance was very low (with mean proportions ranging from 0·01 to 0·04), with no significant differences between any condition.

In the second scoring procedure, participants' responses were again scored with a '1' if correct and '0' if incorrect. However, the criterion was lenient in that responses did not have to specifically match the exact wording of the pictorial description. Instead, descriptions were counted as being correct if synonymous with the short verbal label, indicating participants' basic understanding of the pictorial message content. Two judges scored all of the response sheets without knowing the conditions from which they were taken (i.e. blind). Inter-rater reliability was 90·3% . The data in this report are based on one judge's scores.

Table 2. Proportion correct of easy versus difficult pharmaceutical and industrial pictorials with a verbal label versus verbal label plus explanatory statement.

	Verbal label only				Verbal label plus explanation			
	Pharmaceutical		Industrial		Pharmaceutical		Industrial	
	Easy	Difficult	Easy	Difficult	Easy	Difficult	Easy	Difficult
Pre-training test (n= 60)	0·92	0·50	0·66	0·33	0·86	0·43	0·69	0·32
Immediate post-training test (n= 30)	0·98	0·84	0·94	0·82	0·93	0·85	0·84	0·73
One-week post-training test (n= 60)	0·99	0·84	0·93	0·73	0·95	0·79	0·87	0·71

Means for each experimental condition can be seen in table 2. As discussed earlier, only one-half of the participants took the immediate post-training test, therefore the means in table 2 were calculated using different numbers of participants (i.e. 60 participants took the pre-training and 1-week post-training tests, while 30 participants took the immediate post-training test).

3.1. *Immediate post-training test omitted*

3.1.1. *Main effects:* A 5-factor mixed-model ANOVA omitted scores from the immediate post-training test. The ANOVA showed a significant main effect of time of test, $F(1,56) = 408{\cdot}84$, $p < 0{\cdot}0001$, with comprehension scores higher in the 1-week test ($M = 0{\cdot}85$) than in the pre-training test ($M = 0{\cdot}59$); a main effect of pictorial type, $F(1,56) = 107{\cdot}52$, $p < 0{\cdot}0001$, with comprehension better on the pharmaceutical ($M = 0{\cdot}79$) than the industrial-safety pictorials ($M = 0{\cdot}65$), and a main effect of difficulty level, $F(1,56) = 628{\cdot}99$, $p < 0{\cdot}0001$, with comprehension better for the easy ($M = 0{\cdot}86$) than the difficult pictorials ($M = 0{\cdot}58$).

3.1.2. *Interactions:* The ANOVA also showed a significant 2-factor interaction of time of test and difficulty level $F(1,56) = 106{\cdot}26$, $p < 0{\cdot}01$. This interaction can be seen by inspecting the pre-training and 1-week post-training test means in table 2. The pattern of means show a substantial difference in comprehension between the easy and difficult pictorials at the pre-training test, and while both increased following training at the 1-week test, the increase was more dramatic for the difficult pictorials. That is, the difference between easy and difficult pictorials decreased from the pre-training to the 1-week test. The ANOVA also showed a significant 3-factor interaction of time of test, pictorial type and difficulty level, $F(1,56) = 7{\cdot}90$, $p < 0{\cdot}01$. This interaction is similar to the 2-way interaction except that it specifically indicates that the lesser known pictorials according to the pre-training test (the more difficult industrial-safety pictorials) showed the most impressive increase in comprehension at the 1-week test compared to the pre-training test, whereas better known pictorials (of either pictorial type) did not show as large an increase between the two tests. This pattern was supported by the Newman-Keuls Multiple Range test.

3.2. *Immediate post-training test included*

3.2.1. *Main effects:* A 4-factor mixed-model ANOVA was used to examine the scores from the immediate post-training test. The ANOVA showed a significant main effect of time of test, $F(2,56) = 196{\cdot}0$, $p < 0{\cdot}0001$, with the Newman-Keuls Multiple Range test showing comprehension scores lower in the pre-training test ($M = 0{\cdot}58$) than in the immediate post-training ($M = 0{\cdot}87$) and 1-week post-training ($M = 0{\cdot}86$) tests, with no significant difference between the immediate post-training and 1-week post-training tests. Other main effects included pictorial type, $F(1,28) = 55{\cdot}36$, $p < 0{\cdot}0001$, with comprehension better on the pharmaceutical ($M = 0{\cdot}82$) than the industrial-safety pictorials ($M = 0{\cdot}72$), and difficulty level, $F(1,28) = 341{\cdot}43$, $p < 0{\cdot}0001$, with comprehension better for the easy ($M = 0{\cdot}87$) than the difficult pictorials ($M = 0{\cdot}66$).

3.2.2. *Interaction:* Only one interaction effect was significant: Time of test $\times$ difficulty level, $F(2,56) = 62{\cdot}90$, $p < 0{\cdot}0001$. The pattern of means show a substantial difference in comprehension between the easy and difficult pictorials at the pre-training test (i.e. the easy pictorials had a significantly higher comprehension level), and while comprehension for both pictorial types increased at the 1-week post-training test, the increase was more dramatic for the difficult pictorials. That is, the difference between easy and difficult pictorials decreased from the pre-training to the 1-week post-training test. This pattern was supported by the Newman-Keuls Multiple Range test.

3.3. *6-month post-training test*

Although the data collected in the 6-month post-training test are limited by the fact that a much smaller sample from the original set participated, the results provide some insight into the extent of long-term memory decay. Means for experimental conditions can be seen in table 3. Owing to the limited number of participants tested at the 6-month follow-up, analyses excluded: (a) the scores from the immediate post-training test (as only half of all participants took this test), and (b) the content of instruction variable (as earlier analyses indicated that it produced no significant effect — main effect or interaction).

3.3.1. *Main effects:* A 3-way within-subjects ANOVA was performed. The ANOVA showed a significant main effect of time of test, $F(2,14) = 32{\cdot}83$, $p < 0{\cdot}0001$, with the Newman-Keuls Multiple Range test showing that comprehension scores were lower in the pre-training test ($M = 0{\cdot}64$) than in the 1-week post-training ($M = 0{\cdot}89$) and 6-month post-training ($M = 0{\cdot}85$) tests, with no significant difference between the 1-week and 6-month tests. Other main effects included pictorial type, $F(1,14) = 25{\cdot}12$, $p < 0{\cdot}01$, with comprehension better on the pharmaceutical ($M = 0{\cdot}86$) than the industrial-safety pictorials ($M = 0{\cdot}72$); and difficulty level, $F(1,14) = 129{\cdot}25$, $p < 0{\cdot}0001$, with comprehension better for the easy ($M = 0{\cdot}92$) than the difficult ($M = 0{\cdot}66$) pictorials.

3.3.2. *Interactions:* The ANOVA also showed two significant 2-factor interactions: time of test $\times$ pictorial type, $F(2,14) = 28{\cdot}25$, $p < 0{\cdot}0001$; and time of test $\times$ difficulty level, $F(2,14) = 9{\cdot}98$, $p < 0{\cdot}01$. These interactions are similar to those already described, i.e. (a) there was a substantial difference between the easy versus difficult and pharmaceutical versus industrial-safety pictorials at the pre-training test that was reduced at subsequent tests, and (b) while both showed increased comprehension following training from the pre-training to the 1-week test, the difficult and industrial-safety pictorials showed a more dramatic increase.

Additionally, the ANOVA showed a significant 3-factor interaction of time of test, pictorial type, and difficulty level, $F(2,14) = 3{\cdot}83$, $p < 0{\cdot}05$. The Newman-Keuls test showed a significant increase in scores from the pre-training to the 1-week post-

Table 3. Proportion correct of pharmaceutical versus industrial-safety and easy versus difficult pictorials.

	Pharmaceutical		Industrial-safety	
	Easy	Difficult	Easy	Difficult
Pre-training test	0·92	0·54	0·74	0·34
One-week post-training test	1·0	0·82	0·95	0·77
Six-month post-training test	0·99	0·87	0·91	0·63

training test, and that the higher rate of comprehension was maintained 6 months later. While comprehension of the pharmaceutical pictorials in the 1-week post-training test did not significantly differ from the 6-month post-training test, the industrial-safety pictorials showed a small but significant decline from the 1-week test to the 6-month test. Nevertheless, performance remained significantly higher than in the pre-training test.

4. Discussion

Regarding the full set of data from the 60 participants, results support the expectation that comprehension and retention of pictorial messages can be influenced in several ways. Significant effects of training are seen by comparing scores from the pre-training test and scores in the two subsequent post-training tests. Comprehension scores immediately following training show an increase compared to the pre-training test scores. Moreover, the increased comprehension was maintained 1 week later (irrespective of having taken the immediate post-training test). The positive results support the prediction that presenting pictorials together with their associated verbal labels is an effective way of training people on the meanings of pictorials. This supports the hypothesis derived from dual code theory — that combining verbal and pictorial information facilitates memorial processes. The fact that retention remained high after 1 week may be seen as somewhat surprising, given common rapid (negatively accelerated) memory decay for verbal materials. However, the failure here to see a drop in performance several days after training is not entirely unexpected. Other kinds of complex visual stimuli (e.g. faces) are also maintained in memory over time without rapid forgetting (Laughery and Wogalter 1989).

Although memory performance remained high after 1 week, it is desirable that the effects of training persist beyond this limited time frame. To better understand the long-term forgetting rate, the 6-month post-training test was administered to as many of the original 60 participants as could be gathered. The data showed that the increase in overall pictorial comprehension witnessed 1 week after training was retained 6 months after training. Although the industrial-safety pictorials were not comprehended as well at the 6-month post-training test as they were at the 1-week post-training test, performance nevertheless remained high, and did not return to the low level witnessed prior to training. Given that only one-quarter of the participants were tested, these long-term results can be considered to be suggestive.

Four other points warrant discussion. First, the pre-training test (as seen in table 2) provided an excellent manipulation check for evaluating the selection process used to categorize easy and difficult pictorials. The initial selection of pictorials was based on the comprehension rates in earlier studies, and the present results showed that the earlier studies provided a valid method of categorization. It is also interesting to note that the difficult pictorials (both pharmaceutical and industrial-safety) had pre-training comprehension levels at or below 50%. It is apparent that many of the pictorials in use today fail to convey their intended message.

Second, the high levels of performance for easy pictorials on the pre-training test indicates a ceiling effect. When performance is initially at high levels, only small effects of training are possible. Only for difficult pictorials is the initial level of performance low enough to show substantial training effects. Nevertheless, positive training trends were exhibited for even highly comprehensible (easy) pictorials.

Third, the content of instruction manipulation failed to show the predicted effect that more detailed explanatory descriptions would produce greater memory of the pictorial meanings than the pictorial labels alone. This suggests that the additional verbal information was not beneficial. Possible reasons for the null finding might be: (a) participants' inability to adequately encode the explanatory statements, (b) failure of the explanatory statements to provide additional memory codes beyond those provided by the simple labels, suggesting further testing with more detailed explanatory statements, (c) the testing measure used to quantify retention was not sensitive enough to assess the effect of the more elaborate encoding that might have taken place, or (d) the verbal label alone brought retention to such high levels (a near-ceiling effect) that the explanatory statement could not improve performance much further. At this point, definitive conclusions on the effects of elaborative supplementary information can not be reached.

Fourth, and perhaps the most important finding in this research, is that very brief training that simply provided an associated verbal label substantially increased comprehension of difficult pictorials. It appears that when people do not understand the meaning of a pictorial, a brief description needs only to be provided once, and the meaning is thereafter almost indelibly linked to the pictorial. This finding is important because pictorials are being created and used in a variety of contexts in which their meaning is not always readily apparent. The present results suggest that while highly understandable pictorials should be used when they are available (or can be developed), some training might be necessary when using lesser understood pictorials. Furthermore, the simple pairing of pictorials and textual verbal labels appears adequate as a training trial, and should be used in order to raise comprehensibility whenever possible. A final benefit is that subsequent memory for these pictorials appears to be maintained over long periods of time. As society becomes more technologically driven and culturally diverse, the beneficial nature of using pictorials to convey safety-related information can be better utilized as simple and effective training programmes are developed and employed.

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