

nicative pictorials, it is important to document the process and demonstrate that this set of procedures can produce improved pictorials. Thus, a second purpose of the present research is to describe one of the later phases in this ongoing process of pictorial redesign.

One of the major costs of testing pictorials is the collection of data from the relevant target populations (e.g., the elderly, illiterates, and non-English speakers). Iterative cycles of test and redesign using these populations could be prohibitively expensive for researchers and designers. As outlined in Wolff and Wogalter (1993), this cost can be reduced through preliminary iterative redesign and testing of deficient pictorials using readily-available "convenience" subjects. These procedures are performed under the reasonable working assumption that if educated individuals with good vision are not able to understand the pictorials, it probably indicates that the pictorial will not survive comprehension testing with more disadvantaged populations either.

Because of its iterative nature, the project involves several phases. The first six phases were described in a report by Wolff and Wogalter (1993). In that study, the pictorials were initially tested for comprehension using the International Standards Organization (ISO) criterion of 85% correct as a cutoff value for acceptable pictorials. This standard is arbitrary and, due to the importance of the label information for the safe use of pharmaceuticals, it was considered desirable to increase the comprehension beyond that level if possible. When an error analysis of participant responses indicated a high level of wrong answers and perhaps more importantly, confusion, pictorials were redesigned in an effort to clarify the pictorial with respect to the intended concept. Wolff and Wogalter (1993) presented an analysis of subjects' incorrect responses and described the use of focus groups to generate alternative images for the misunderstood pictorials. The present research describes the testing of the pictorials created subsequent to the Wolff and Wogalter (1993) study.

METHOD

Participants

Two hundred sixty-five individuals from North Carolina State University and the Raleigh, North Carolina community were tested. These individuals ranged in age from 11 to 74 ($M = 26.8$, $SD = 11.1$), were almost equally divided on gender (49% male, 51% female), and included students (54%), full-time working people (41%), and unemployed or retired individuals (3%). Ethnic backgrounds generally approximated the national distribution, with 80% Caucasian, 12% Afro-American, 5%

Asian, 1.5% Hispanic, and 1.5% other. Participants' education levels were 11% high school or less, 62% technical training or some college, and 27% college graduate.

Materials and procedure

Thirty original USPC pictorials and 38 revised pictorials were tested. The original pictorials were retested in this study to further document available comprehensibility. Fifteen concepts were represented only by the original USPC pictorial. For the other 15 concepts, the original versions were tested as well as redesigns based on the earlier findings by Wolff and Wogalter (1993). Some revised versions were tested for concepts that had achieved 85% or greater comprehension in earlier testing but for which higher ratings were desired. The pictorials were randomly assigned to groupings and assembled into booklets with 30 randomly ordered pictorials in each booklet. Only one pictorial for a given concept was assigned to a booklet to avoid assisting subjects on subsequently answered pictorials, and thus, any one pictorial was seen by only a subgroup of participants. The number of subjects viewing any given pictorial ranged from 35 to 265 participants. Participants were instructed to write out the meaning of each pictorial on a numbered answer sheet.

RESULTS

Responses were scored by two judges. To be scored correct, answers had to indicate that the participant understood the basic meaning of the verbal descriptions that accompanied the original USPC pictorials. Criteria were established before the scoring procedure took place as to what constituted the conceptual elements necessary for a correct response. Inter-observer agreement (number of times the two judges agree divided by number of opportunities to agree) was .93.

Eighteen of the original USPC pictorials performed at or above 85% comprehension (ISO cutoff) in this study, confirming many of the findings of Wolff and Wogalter (1993). Five of these concepts were also tested in revised form in an effort to improve comprehensibility. Three of the redesigns were more successful in capturing the correct responses than the originals. For example, the original pictorial for the concept "Store medicine out of reach of children" scored at 89% comprehension in this study. The four revised versions for this pictorial were higher (see Figure 1), ranging from 93% to 100% comprehension.

Twelve of the 30 USPC pictorials did not perform above the ISO cutoff of 85% comprehension. Redesigns for four of these concepts (i.e., "Do not break or crush

