COMPREHENSION OF AVIATION SAFETY PICTOGRAMS: GENDER AND PRIOR SAFETY CARD READING INFLUENCES

N. Clayton Silver and Carla N. Perlotto
University of Nevada, Las Vegas
Las Vegas, NV 89154-5030

The present study assessed the comprehensibility of aviation safety pictorials that compose specific pictograms. A total of 120 individuals were asked to provide detailed responses to each pictorial that comprised a pictogram. The seven categories of pictograms were: (a) take-off, landing, and surface movement; (b) oxygen; (c) in flight; (d) land evacuation; (e) emergency/brace position and floor lighting; (f) water evacuation; and (g) water evacuation - on overwater aircraft. Results indicated that 21 of the 40 pictorials presented were within the acceptable range of the ISO 67% comprehension criterion, whereas only 11 of the 40 pictorials were within the ANSI 85% comprehension criterion. Comprehension of the pictorials comprising the oxygen pictogram was the highest among the seven categories of pictograms tested. However, the pictorials that connoted "move away from the aircraft", which were found in the land evacuation pictograms, were the least comprehended. Implications for aviation safety card design are discussed.

INTRODUCTION

Federal Aviation Administration regulations (FAA, 1967) require that all airlines provide passengers with both oral and written safety briefings in case of an emergency. Moreover, the safety cards are required to be both visible and available to each passenger at all times during the flight.

As Schmidt and Kysor (1987) pointed out, aviation safety cards differ along many asthetic dimensions (e.g., color, layout). Yet topics such as emergency exits, evacuation slides, oxygen, seatbelts, brace positions, and individual flotation devices need to be covered on each safety card (FAA, 1967). Moreover, another common denominator among safety cards is that they should be able to convey the necessary information to the widest possible audience.

One such design for conveying this information quickly was proposed by Altman, Johnson, and Blom (1970). They suggested that the safety card should include simple ordered actions, pictorial displays, and a minimal amount of words. In testing various instructional designs, Schmidt and Kysor (1987) found that individuals preferred pictures presented in sequential fashion (i.e., pictograms) or words presented with diagrams. However, Jentsch (1996) pointed out that because of the propensity of international travel, the information conveyed must be provided in a "culture-free" environment. Consequently, designing safety cards that include words presented with diagrams might be problematic.

Therefore, designing safety cards with pictograms might be more appropriate. However, it should be noted that pictograms, which are composed of pictorials (i.e., individual pictures), should meet a certain comprehension standard. The ISO 7001 (1979) minimum comprehension standard for pictograms is 67%, whereas the ANSI Z535.3 (1991) standard is 85%. Yet even commonly used safety pictorials do not meet these criteria (Collins, Lerner, and Pierman, 1982; Laux, Mayer, and Thompson, 1989; Silver et al., 1995). In an examination of isolated aviation safety pictorials, Jentsch (1996), using a strict criterion, found that over 66% of the pictorials tested failed to meet the comprehension standards. Using a more lenient criterion, he found that the comprehension standards were met for the majority of pictorials. Therefore, one purpose of the present study was to expand on the results of Jentsch (1996) by testing the comprehension rates of pictorials composing various pictograms on an actual safety card.

Although the airlines conform with the regulation to present safety briefings, passengers may only listen to the flight attendant's oral presentation and ignore the safety card, or they may disregard both altogether (Lundstrom, 1988). Altman, Johnson, and Blom (1972) reported that as few as 15% of all passengers attend to the briefing given by the flight attendants or pilots. Business travelers, who are often the most frequent fliers, are least likely to look at safety cards, whereas women and vacationers are more likely to review the cards (Lundstrom, 1988). If a passenger simply reviewed the card or was provided some training, then higher rates of comprehension and retention would probably be obtained (Brelsford, Wogalter, and Scoggins, 1994). Therefore, a second purpose of the present study was to investigate if those who claimed to have examined a safety card at any time during a flight would have greater comprehension of pictorials than those who reported that they have not.

METHOD

Participants:

A sample of 120 undergraduate students (50 males and 70 females) from the University of Nevada, Las Vegas (mean age = 20.39, SD = 3.87) voluntarily completed the

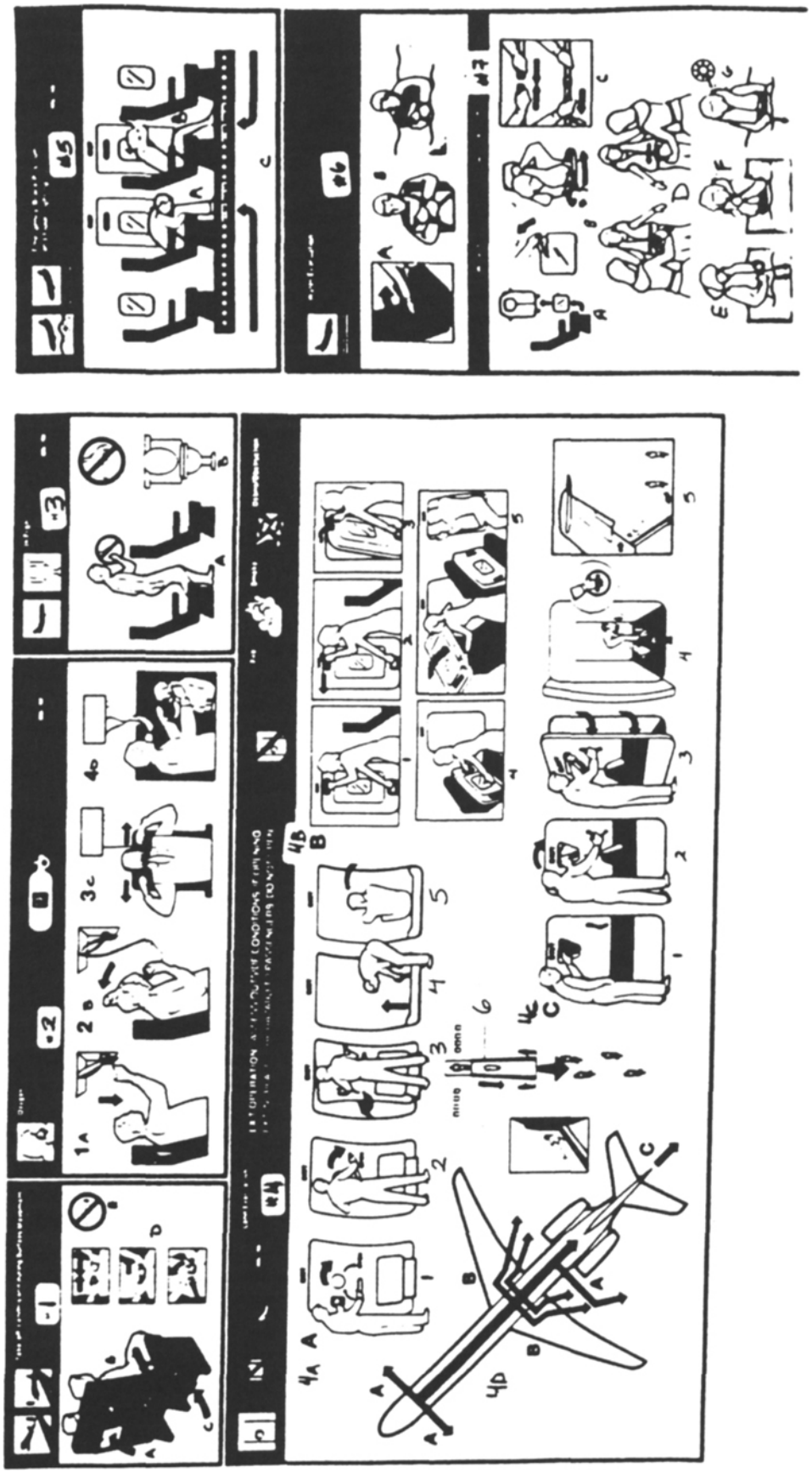

Figure 1: Categories of Aviation Safety Pictograms

study. Of these 120 individuals, only two individuals had not flown before. Moreover, 73 participants (60.8%) claimed that they had read an aviation safety card before.

Materials and Procedure

All individuals were shown a McDonnell-Douglas Super 80 LuxuryJet safety card. The safety card mostly consists of pictograms with brief headings (written in English). These headings divided the pictograms into seven categories. These categories were: (a) take-off, landing, and surface movement; (b) oxygen; (c) in flight; (d) land evacuation; (e) emergency/brace position and floor lighting; (f) water evacuation; and (g) water evacuation - on overwater aircraft. Three separate subcategories of pictograms were illustrated for land evacuation. These subcategories consisted of door exits, over wing exits, and tail exits. All pictograms were depicted in color and are shown in Figure 1. A page of text concerning exit row instructions written in English, French, German, Spanish, and Japanese was placed on the back of the safety card. However, only the pictograms were used for the purpose of this study.

Within each pictogram heading, which was numbered for ease of responding, all participants were queried to write down in detail what each pictorial meant. A demographics questionnaire that included questions concerning previous flight experience was also administered.

RESULTS

All responses to the pictorials were provided by a pilot with over 30 years of flying experience. Based upon his answers, all participants' responses were scored as dichotomous data (either correct or not correct). Table 1 shows the mean comprehension levels along with the 95% confidence intervals for each pictorial tested. As demonstrated by the confidence intervals in the table, of the 40 pictorials tested, 21 exceeded the ISO 67% criterion and only 11 exceeded the ANSI 85% criterion.

Nine separate sex (male or female) x whether they have ever read a safety card before (either yes or no) x pictorial (with levels ranging from two to seven) mixed-subjects analyses of variance (ANOVAs) were conducted for each category of pictogram. Sex and reading a safety card were the between-subjects variables, whereas pictorial was the within subjects factor. The dependent variable was comprehension. All subsequent tests were performed using the Student Newman-Keuls multiple range procedure.

Take-off, landing and during surface movement. The ANOVA revealed a significant effect for pictorial, $F(4, 464) = 21.63$, $p<.0001$ and a reading safety card x pictorial interaction, $F(4, 464) = 3.01$, $p<.02$. Over 99% of the participants understood "fasten seat belts" (see Pictorial 1D), however, only 54% understood the pictorial "stow away tables" (see Pictorial 1A). With regard to the interaction, those who never read a safety card before had significantly better knowledge of the no smoking icon than those who claimed to have read the safety card before.

Oxygen. The ANOVA showed statistically significant effects for reading the safety card, $F(1, 116) = 5.17$, $p<.03$; pictorial, $F(3, 348) = 42.38$, $p<.0001$; and the gender x pictorial interaction, $F(3, 348) = 4.17$, $p<.01$. Those who claimed reading a safety card before comprehended the pictogram better than those who had not. Moreover, males comprehended the "adjust straps" pictorial (see Pictorial 2C) better than females did. Only 61% of all participants comprehended that pictorial.

In flight. More individuals understood the "no smoking in the lavatory" pictorial (see Pictorial 3B) than they did the "no smoking in the aisles" pictorial (see Pictorial 3A), $F(1, 116) = 108.65$, $p<.0001$. The "no smoking in the lavatory" pictorial met the ISO 67% comprehension criterion, whereas the "no smoking in the aisles" pictorial met neither comprehension criteria.

Land evacuation. Three separate mixed-design ANOVAs were conducted for this category.

Door exits. Those who claimed to have read a safety card before comprehended the door exit pictogram better than those who claimed that they have never read a safety card, $F(1, 116) = 5.24$, $p<.03$. A statistically significant pictorial effect, $F(4, 464) = 97.31$, $p<.0001$, indicated that the pictorials depicting "move the handle in the direction of the arrow" (see Pictogram 4A - pictorials 1 and 2) and "open door" (Pictogram 4A - pictorial 3), which met both the ISO and ANSI comprehension criteria, were easier to comprehend than "move away from the aircraft" (Pictogram 4A - pictorial 6), $ps<.0001$.

Over wing exits. A statistically significant pictorial effect, $F(3, 354) = 23.73$, $p<.0001$ indicated that the pictorials depicting "open the door handle" (Pictogram 4B - pictorials 1 and 2) and "set the door on the seat" (Pictogram 4B - pictorial 4), which met the ISO 67% comprehension criterion, were more easily comprehended than "remove door" (Pictogram 4B - pictorial 3), $ps<.0001$.

Tail exit. The pictorials depicting to "move the handle in the direction of the arrow" (Pictogram 4C - pictorial 2) and "open the door" (Pictogram 4C - pictorial 3), which met the ISO 67% comprehension criterion, were more easily comprehended than "exit in a sitting position and move away from the aircraft" (both activities are conveyed in Pictogram 4C - pictorial 5), $ps<.0001$.

Emergency/brace position and floor lighting. A statistically significant pictorial effect, $F(2, 232) = 4.59$, $p<.02$ revealed that the pictorial depicting "place the head between the knees" (Pictorial 5A), which met the ISO 67% comprehension criterion, was more understandable than the pictorial connoting "brace against the seat in front of you" (Pictorial 5B) and "floor lights leading to the emergency exits" (Pictorial 5C), $ps<.04$.

Water evacuation. The pictorial connoting "use the seat cushion as a flotation device" (Pictorial 6A), which met both comprehension criteria, was more understandable than the pictorial connoting "cross the arms through the straps" (Pictorial 6B), $F(1, 116) = 156.17$, $p<.0001$.

Table 1. Means, standard deviations, and confidence intervals of comprehension for each pictorial (N=120).

Pictogram/Pictorial	Comprehension Proportion Correct Mean	SD	95% Confidence Interval
Take-Off, Landing and During Surface Movement			
1a Stow Away Tables	.53	.50	$.44 < \mu < .62$
1b Seat Back Upright	.73	.44	$.65 < \mu < .81$
1c Baggage Under Seat	.81	.38	$.74 < \mu < .88$
1d Fasten Seat Belt	.99	.09	$.97 < \mu < 1.0$
1e No Smoking	.71	.45	$.62 < \mu < .79$
Oxygen			
2a Pull Mask Toward Yourself	.95	.21	$.91 < \mu < .98$
2b Don Mask	.95	.19	$.92 < \mu < .99$
2c Adjust Straps	.61	.48	$.52 < \mu < .69$
2d Help Small Children	.96	.17	$.93 < \mu < .99$
In Flight			
3a No Smoking in Aisle	.22	.41	$.14 < \mu < .29$
3b No Smoking in Lavatories	.76	.42	$.68 < \mu < .83$
Land Evacuation			
Door Exits			
4a (1,2) Move Handle in Direction of Arrow	.77	.41	$.70 < \mu <. 85$
4a (3) Open Door	.78	.41	$.71 < \mu < .85$
4a (4) Pull Slide Handle	.38	.48	$.29 < \mu < .46$
4a (5) Exit in Sitting Position	.24	.43	$.16 < \mu < .32$
4a (6) Move Away From Aircraft	.03	.17	$.00 < \mu < .06$
Over Wing Exits			
4b (1,2) Open Upper Handle	.74	.43	$.66 < \mu < .82$
4b (3) Remove Door	.38	.48	$.29 < \mu < .46$
4b (4) Set Door on Seat	.66	.47	$.57 < \mu < .74$
4b (5) Exit Through Door	.57	.49	$.48 < \mu < .66$
Tail Exits			
4c (1) Pull Down Guard	.48	.50	$.39 < \mu < .57$
4c (2) Move Handle in Direction of Arrow	.70	.45	$.61 < \mu < .78$
4c (3) Open Door	.77	.41	$.70 < \mu < .85$
4c (4) Exit Through Tail	.30	.46	$.22 < \mu < .38$
4c (4) Pull Slide Handle	.28	.45	$.19 < \mu < .36$
4c (5) Exit in Sitting Position	.17	.38	$.10 < \mu < .24$
4c (5) Move Away From Aircraft	.12	.33	$.06 < \mu < .18$
All Exits			
4d There are Eight Exits as Shown	.85	.34	$.79 < \mu < .92$
Emergency/ Brace Position and Floor Lighting			
5a Place Head Between Knees	.66	.47	$.58 < \mu < .75$
5b Brace Against Seat in Front of You	.54	.50	$.45 < \mu < .63$
5c Floor Light Lead to Emergency Exits	.47	.50	$.38 < \mu < .56$
Water Evacuation			
6a Use Seat Cushion as Flotation Device	.90	.30	$.84 < \mu < .95$
6b Cross Arms Through Straps	.25	.43	$.17 < \mu < .33$
Water Evacuation - On Overwater Aircraft			
7a Life Preserver is Under Seat	.85	.35	$.78 < \mu < .91$
7b Put Life Vest Over Head and Secure	.76	.42	$.69 < \mu < .84$
7c Fasten Buckle	.61	.48	$.53 < \mu < .70$
7d Help Children After Your Vest is on	.67	.46	$.59 < \mu < .76$
7e Inflate Vest When in Water - Pull Tabs	.42	.49	$.34 < \mu < .51$
7f Vest can Inflate Orally Through Tubes	.56	.49	$.47 < \mu < .65$
7g Light Shines in Water When Tab Pulled	.23	.42	$.16 < \mu < .31$

Water evacuation - on overwater aircraft. A statistically significant effect of pictorial, $F(6, 696) = 31.71$, $p<.0001$, revealed that the pictorials connoting "life preserver is under the seat" (Pictorial 7A), "tear open the bag, put the life vest over the head, and secure it around the waist" (Pictorial 7B), which met the ISO 67% comprehension criterion, were easier to comprehend than "light will illuminate in water when inflation tab is pulled" (Pictorial 7G), $ps<.0001$.

DISCUSSION

Overall, about 50% of the pictorials tested met the ISO 67% comprehension standards, whereas, only about 25% met the ANSI 85% comprehension standards. Pictorials within the Oxygen pictogram were the easiest to comprehend and the "fasten seat belt" pictorial was known by nearly all participants. However, pictorials such as "move away from the aircraft", "exit in a sitting position" and "no smoking in the aisles" were the most difficult to comprehend. Interesting of note was that instead of responding "no smoking in the aisle," some participants responded "no smoking on your way to the bathroom", whereas others responded "no smoking". Because a stringent criterion was used, "no smoking" would be considered inadequate as various international flights (e.g., South America) do indeed allow smoking. Furthermore, instead of responding "light shines in water when the tab is pulled," (Pictorial 7G), numerous respondents provided the answer "when you pull on the vest, the sun shines on your back." Nonetheless, given these stringent criteria, the present results corroborate the work by Jentsch (1996).

There may be a number of reasons why the comprehensibility of pictorials were low. First, in some cases (Pictogram 4C - pictorials 4 and 5), there are two distinct pieces of information that correspond to that pictorial. That is, "exit through tail" and "pull slide handle" for pictorial 4 and "exit in a sitting position" and "move away from the aircraft" for pictorial 5. Perhaps providing only one piece of information per pictorial would make it somewhat easier to comprehend. In other cases, "move away from the aircraft" (Pictogram 4A - pictorial 6), the respondent had difficulty associating that pictorial with the door exit pictogram. That is, the pictogram is provided in a left-to-right (normal English reading) sequence. However, when a pictorial which completes the pictogram is placed in a position that is incongruent with the normal sequence, then the comprehensibility seems to be lessened.

Although there were no appreciable differences in comprehensibility of pictorials or pictograms between genders and whether they have examined a safety card before, it appears as if individuals have difficulty in understanding the specific details of the pictorial (Jentsch, 1996). Furthermore, as Silver et al (1995) have pointed out, even if a pictorial is found to be understood by 86% of those tested, which would be considered "acceptable" by standard comprehension criteria, there are another 14% who do not understand the pictorial. Therefore, each pictorial presented should be "understandable" in order to aid the individual in comprehending the entire message of the pictogram. This is extremely crucial given the potential life and death nature of accidents occurring in commercial airplanes.

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