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The Development of Graphic Symbols for Medical Symptoms to Facilitate Communication between Health Care Providers and Receivers

MASAKI MORIYAMA, DELWYN L. HARNISCH* and SHINICHI MATSUBARA†

*Department of Preventive Medicine and Health Promotion, Nagasaki University School of Medicine, Nagasaki 852, *Department of Educational Psychology, University of Illinois at Urbana-Champaign, Champaign, Illinois, USA, and †Department of Education, Shiga University, Otsu 520*

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—— Since there are a variety of communication barriers in health care settings in Japan, a study was designed to improve communication by the use of graphic symbols. At the beginning of this study, graphic symbols were developed to correspond to 26 basic symptoms. Seventy-six subjects voluntarily evaluated the comprehensibility of these symbols: nursing students ($n=29$), manual sign language interpreters ($n=24$), hearing impaired subjects with normal ($n=10$), limited ($n=11$), and minimal ($n=2$) literacy abilities. The comprehension by each respondent of each symbol was compared with that of the authors. On the average, numbers of the matching meanings were 24.9 ± 1.36 (mean$\pm$S.D.) for students, 24.5 ± 1.77 for interpreters, 23.4 ± 2.22, and 21.5 ± 3.01 for the first two groups of the hearing impaired. Among the 26 symbols, 10 showed high levels of the matching rates ($>90\%$) for all groups. These symbols were considered to be effective alternatives to verbal expression. Further refinements of the graphic symbols were suggested to suppress the differences in interpretation of the remainder of the symbols. During this study, colleagues and subjects suggested cognitive strategies to clarify and enhance the meaning of the graphic symbols such as (a) the subtraction of excessive information, (b) the addition of further information, and (c) the simplification of the setting by minimizing social and cultural bias.

———— communication barriers; communication aids; professional-patient relations; visual symbols; deafness

Verbal expression of unusual changes of bodily sensation, function, and appearance is usually the first step of communication in health-care settings

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Address for reprints: Masaki Moriyama, M.D., Department of Preventive Medicine and Health Promotion, Nagasaki University School of Medicine, Nagasaki 852, Japan.

between health care providers (such as physicians, nurses, etc.) and receivers (such as patients, community people, etc.). In some situations, however, this verbal communication does not proceed smoothly, for example when the receiver cannot understand the language used and/or when the receiver suffers from hearing impairment. Recently, various kinds of voluntary groups and task forces in Japan have started activities to assist health-related communication programs such as the building voluntary networks for language interpretation (Kobayashi 1992), publishing multi-language descriptive forms for foreigners (Kunii 1991), and publishing advisory pamphlets for the hearing-impaired (Mihara 1992). Although these activities are encouraging, they are still preliminary, and empirical research to assist these programs is necessary.

The goals of this present research are to assess and to solve some of the problem of disturbed communication in the field of community health. To attain the first goal of problem assessment, a researcher is required to be an unbiased observer, merely conducting surveys and analyzing data. However, when solving problems, the researcher is expected to identify the needs of people and to resolve them by helping people meet their needs. When the urgent situation of disturbed communication was considered, the authors gave priority to the second goal of problem solving, and they began a research program aimed at finding practical solutions.

For a possible solution, the authors selected graphic symbols for medical symptoms. One of the reason for this selection is that visual representations are very powerful in communicating messages rapidly (Sato 1990; Tufte 1990) without relying heavily on verbal expression. A second reason is that visual expression is able to cross age and language boundaries and can be understood by all people (Ota 1993). In the present study, the authors aimed at developing graphic symbols to represent medical symptoms to assist the communication process. The challenge for this research is that although a tremendous amount of graphics and cartoons has recently been used in periodicals for nursing and in health promotion journals published in Japan, few rules or methodologies have been offered to represent symptoms. Therefore, the authors accumulated some empirical knowledge by drawing symbols for medical symptoms on a trial-and-error basis, with the assistance of colleagues.

Subjects and Methods

Development of graphic symbols

At the beginning, the research plan was presented to students of Nagasaki University and volunteers were recruited to draw symbols. Two medical students applied and drew their version of symbols for basic symptoms. The drawing proceeded on the basis of free imagination and association of visualized ideas. Two other college students joined to introduce new images related to symptoms. A second group of medical students and three faculty members helped improve the

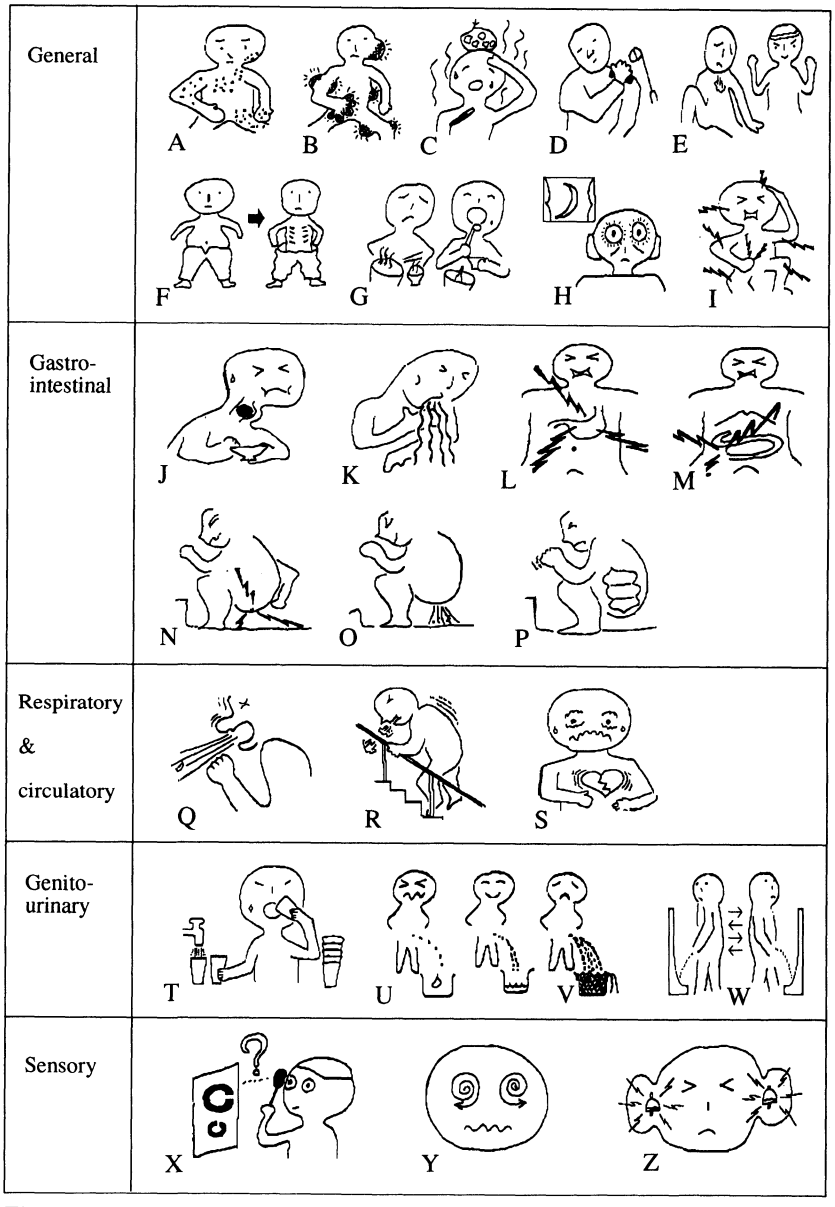

Fig. 1. Twenty-six medical symptoms portrayed. Each of twenty-six graphic symbols corresponds to the following symptoms: *A*, spots on the skin; *B*, swelling of the skin; *C*, feverish; *D*, shoulder stiffness; *E*, fatigue; *F*, overweight or underweight; *G*, loss of appetite; *H*, inability to sleep; *I*, general pain; *J*, difficulty to swallow; *K*, vomiting; *L*, pain of the upper abdominal region; *M*, pain of lower abdominal region; *N*, pain of the anus; *O*, diarrhea; *P*, constipation; *Q*, coughing; *R*, shortness of breath; *S*, palpitation of the heart; *T*, excessive drinking of water; *U*, difficulty in urinating; *V*, too much urine; *W*, too frequent urination; *X*, difficulty in seeing *Y*, dizziness; *Z*, ringing in the ears.

comprehensibility of these initial symbols. The improved symbols were then inspected by a task force outside the university, which included two people with hearing impairments and an expert interpreter of manual sign language. Twenty-six symptoms were finally expressed as graphic symbols (Fig. 1). This developmental stage took place from November 1990 to March 1991.

Questionnaire

To assess a subject's recognition and perception of the twenty-six symbols, a questionnaire was prepared. In the written instruction of the questionnaire, subjects were asked to inspect each symbol and to write down what they thought it meant. As shown in the legend of Fig. 1, the authors gave each symbol an intended meaning. The interpretation of each symbol by each subject was compared with that of the authors and the number of matched meanings were counted.

Subjects

During the period from March to July, 1991, seventy-six subjects volunteered to evaluate the comprehensibility of the symbols. All subjects were residents of Nagasaki city and its surroundings. Subjects consisted of four groups; community health nursing students with normal hearing ability (students, $n=29$), manual sign language interpreters with normal hearing ability (interpreters, $n=24$), hearing impaired subjects with normal literacy (hearing impaired I, $n=10$), hearing impaired subjects with limited literacy (hearing impaired II, $n=11$), and hearing impaired subjects with minimal literacy (hearing impaired III, $n=2$) (Table 1).

TABLE 1. *Characteristics of five groups studied*

	Number of subjects (males, females)	Age (years) mean±S.D. (Min-Max)	Hearing ability	Literacy
Students	29 (0, 29)	21.2±0.62 (21-24)	Normal	Normal
Interpreters	24 (2, 22)	42.8±9.43 (23-65)	Normal	Normal
Hearing impaired I	10 (3, 7)	34.2±8.30 (21-51)	Impaired	Normal
Hearing impaired II	11 (4, 7)	39.2±18.99 (22-78)	Impaired	Limited
Hearing impaired III	2 (0, 2)	65 (54-76)	Impaired	Minimal

Results

Group based comprehensibility of symbols

For the first three groups (students, interpreters and hearing impaired I), there were no communicative difficulties in the survey by questionnaire. All subjects could understand the written instructions, inspect the symbols, and write down their perceptions of their meaning. On average, the number of matching meanings was 24.9±1.36 (mean±S.D.) for students, 24.5±1.77 for the interpreters, and 23.4±2.22 for the hearing impaired I (Table 2). According to multiple comparisons using the Scheffe tests (SPSS Inc. 1990), these differences were not statistically significant ($p>0.05$).

The hearing impaired II subjects were not independent enough to write down all of their perceptions completely by themselves because subjects were more fluent in manual sign language than in communicating by writing. All of subjects understood the purpose of study and actively responded to the graphic symbols. If necessary, interpreters read the subjects' manual sign language and wrote this down for the subjects. The number of matching meanings of the hearing impaired II group (21.5±3.01) was significantly lower than that of students and interpreters ($p<0.05$ by Scheffe tests).

The hearing impaired III subjects (SH and MA) had difficulty in reading and writing because of their limited opportunities to get elementary education. Although both subjects did not fully understand the written part of the questionnaire, they actively responded to the graphic symbols by pointing out some of them. In order to confirm whether they really understood symbols or merely responded to them, a manual sign language interpreter helped with the interview. After an hour-long interview, it was clear that subject SH shared the perception of 20 symbols and subject MA shared 5.

Table 2. *Resemblance of subject's recognition of twenty-six graphical symbols by questionnaire survey*

Group	Number of subjects	Resemblance of comprehension		
		Matched[a]	Unmatched[b]	No answer
Students	29	24.9±1.36	1.1±1.36	–
Interpreters	24	24.5±1.77	0.9±1.41	0.5±1.14
Hearing impaired I	10	23.4±2.22	0.9±0.88	1.7±1.83
Hearing impaired II	11	21.5±3.01	2.4±2.69	2.1±2.17

[a]The respondent's comprehension matches with the authors' comprehension; [b]The respondent's comprehension differs from the authors' comprehension.

*$p<0.05$ by Sheffe tests.

Symbol and comprehension

The comprehension of the symbols was not uniform. Some symbols were more easily understood than others. Intending to determine the differential of comprehension for each unique symbol, two rates of comprehension status (matched and unmatched) were calculated for each symbol. In Fig. 2, symbols are arranged in the descending order of matched comprehension for the entire group. For the top ten symbols, matched comprehension was observed in more than 90% of the subjects, regardless of group membership. In the following seven symbols (from 11th to 17th), the normal group and the hearing-impaired I group stayed at this high level (>90%) of matched comprehension, but the hearing-impaired II group tended to be at a level below 90%. For the remaining nine symbols (from

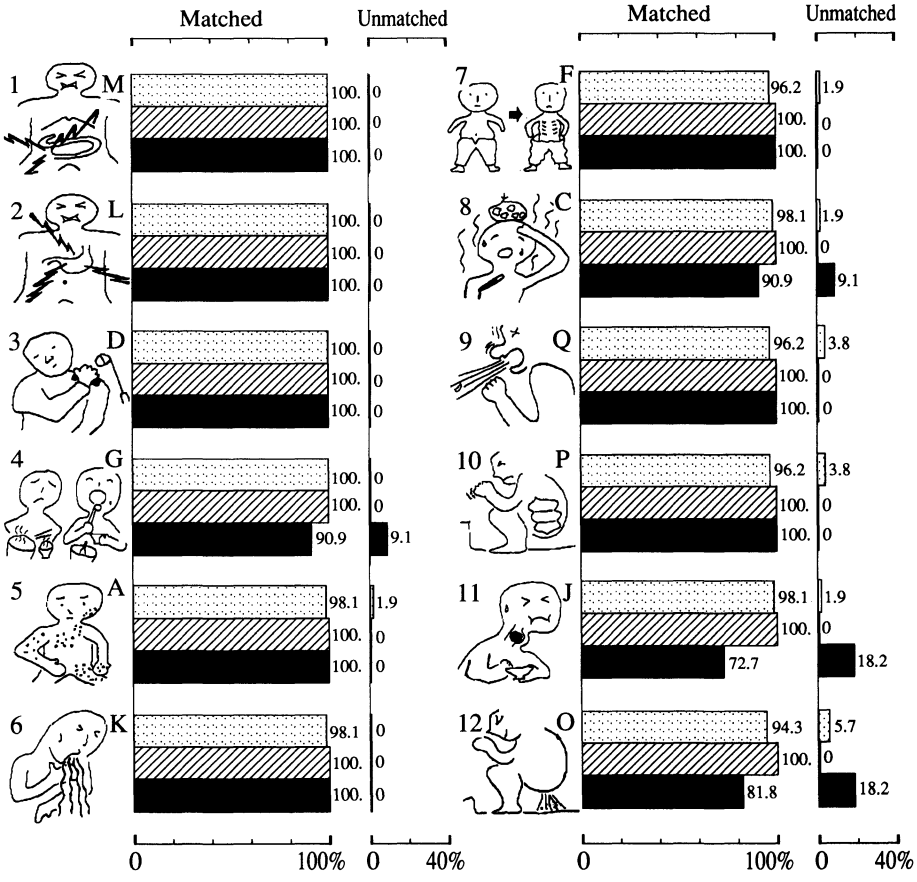

Fig. 2. Graphic symbols in order of the rate of matched comprehension. Rates of comprehension status (matched & unmatched) were calculated for the normal hearing group ($n=53$; students and interpreters were combined), the hearing impaired I group ($n=10$), and the hearing impaired II group (n=11). ▒ normal hearing group; ▨ hearing impaired I; ■ hearing impaired II.

18th to 26th), the normal group still kept the relatively high level (>85%) of matched comprehension, but both hearing-impaired groups showed a lower level.

In Fig. 2, the unmatched comprehension rates are shown in addition to the matched comprehension rate. The tendency of differences in comprehension is more obvious on the continued part of Fig. 2, for the bottom fourteen symbols (from 13th to 26th) except the 20th. The highest rate of unmatched comprehension was observed for the 21st and 24th symbols. For the 21st symbol, the authors' intended meaning was "fatigue". The unmatched interpretations were "difficulty in breathing", "doing exercises" and "nervousness". For the 24th symbol, the authors' intended meaning was "difficulty in seeing". The most common unmatched comprehension was "eye test".

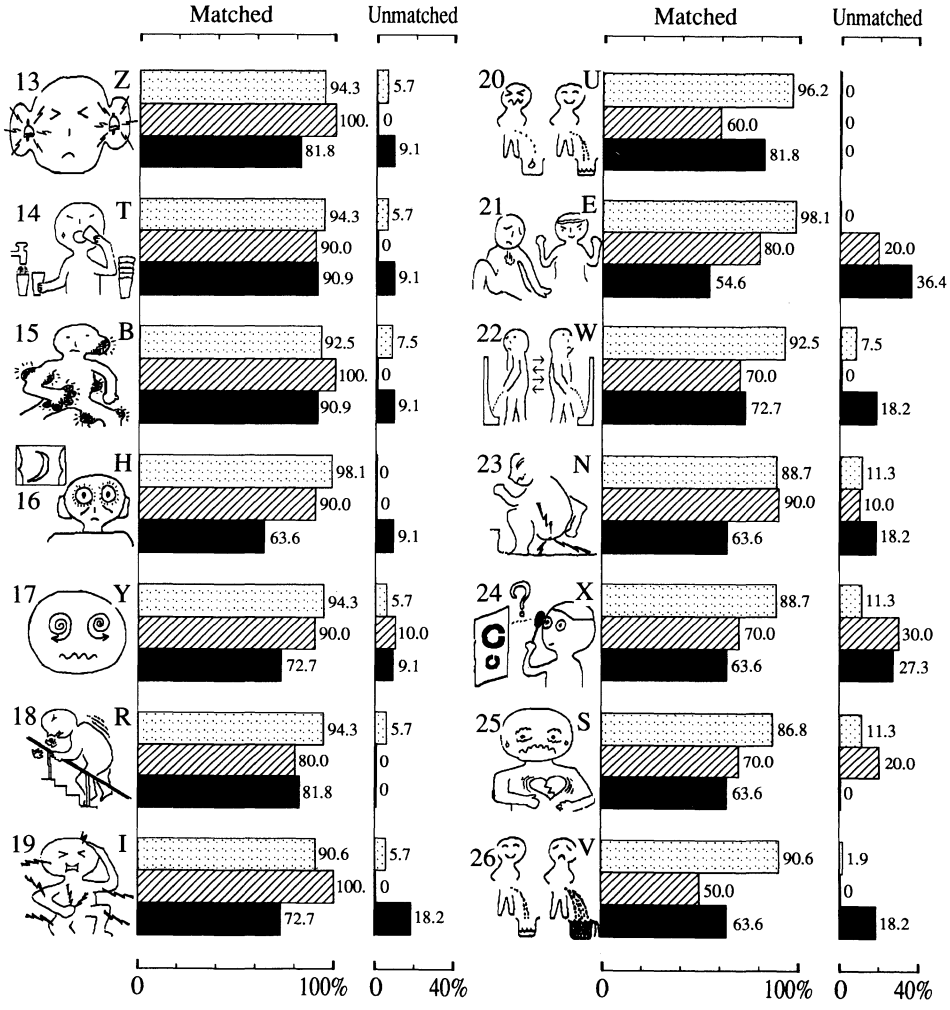

Fig. 2. (continued)

Strategies for the improvement of symbol clarity

Many suggestions were made during the trial period to improve the clarity of the symbols. These suggestions were summarized according to the following criteria; "A, the subtraction of excessive information"; "B, the addition of further information"; and "C, the simplification of the setting by minimizing social and cultural bias." Graphic examples of these points are presented in Fig. 3. by pairs of symbols, in which the one on the right is an improvement of the one on the left according to the stated criterion.

The first two categories of suggestions (A and B) were made during the early stage of developing the symbols. The subtraction of excessive information was further divided into "A1, simplification" and "A2, exaggeration". The impor-

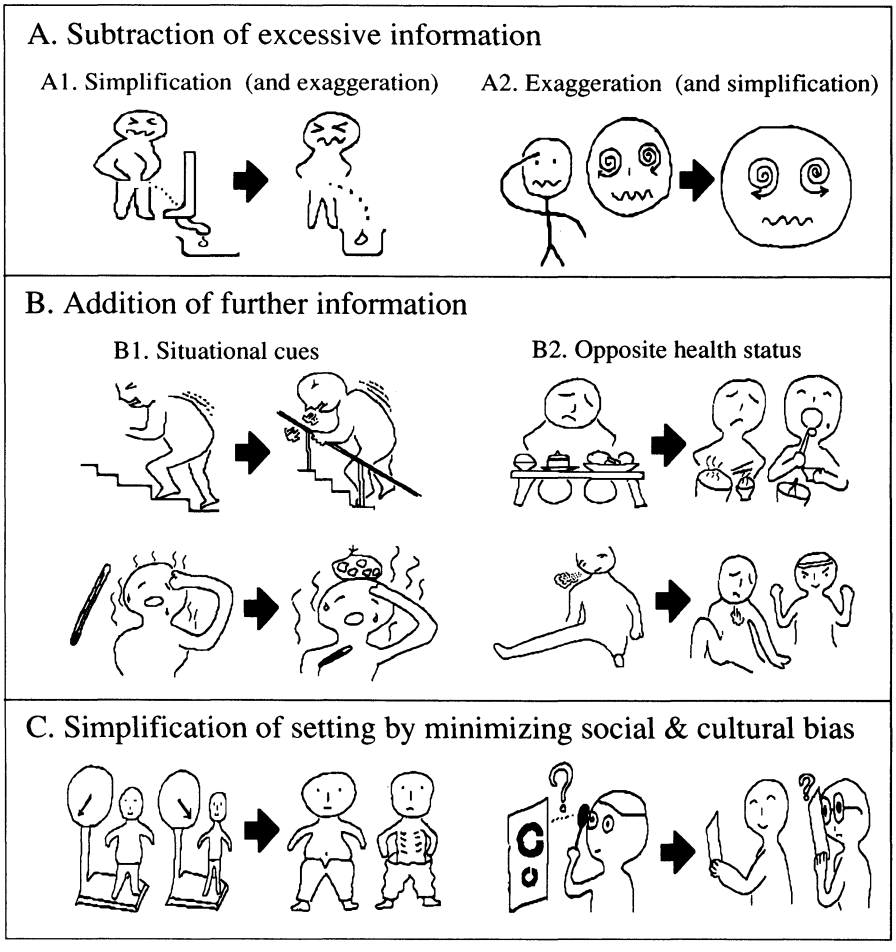

Fig. 3. Cognitive strategies to clarify and enhance the meaning of graphic symbols.

tance of A1 and A2 was repeatedly recognized during the phase of developing the instrument. Although subtraction was a useful strategy to clarify the graphic meaning, an alternative strategy (B, the addition of information) was also useful in some settings. One way of adding information is shown in the case of "B1, situational cues". Adding images of stairs and a handrail clarified the symptomatic image of "palpitation", and adding the image of an ice pillow clarified the symptom of "fever". Another way of adding is shown in the case of "B2, opposite health status". When the meaning of the initial symbol was not clear, the addition of the second symbol as a contrast to the first clarified the overall meaning. The symbol for the symptoms of "loss of appetite" and "fatigue" were clarified by adding images of "good appetite" and "vitality".

The suggestion "C, the simplification of the setting" was obtained during the questionnaire survey and the following interviews. For example, when the authors developed the initial graphic symbols, they used graphic symbol of an upright weight scale and an eye test chart to represent weight increase/decrease and difficulty in seeing. The upright weight scale and eye test chart are common and basic implements used for school based health examinations in Japan. Also, in Japan, the general public has been required to attend elementary school since the beginning of this century. Therefore, according to the authors, the graphic symbols of a weight scale and an eye test chart would trigger the accompanying image of the intended health status. However, this did not occur in the hearing impaired III group. For various reasons, these subjects did not attend elementary school and, therefore, did not have school based annual health examinations. Therefore, instead of the images of a weight scale and an eye test chart, the authors used the images of "loose trousers" and "an eye too close to an object" images. This type of modification is neither a subtraction nor an addition of information. Rather, it is the adoption of a simpler symbol and representing a more fundamental life-style by minimizing social and cultural cognitive bias.

Discussion

Generally, in community based questionnaire surveys in Japan, researchers assume that subjects can respond to the questionnaire without any difficulties in cognition and communication. This is not the case in the present study. Twenty-three subjects had hearing impairment and thirteen of these also had limited literacy. This meant that the sample in the present study contained a marginal population for which an ordinary questionnaire survey was not sufficient to obtain subjects' meaningful responses. In this situation, data were obtained with the cooperation of the subjects. Because priority was given to the problem solving approach, we gradually involved students, manual sign language interpreters, and the hearing impaired to develop and improve the graphics. Thus the initial problem solving approach changed into problem sharing with subjects. This resulted in the active cooperation of subjects in assessing the meaning of the

symbols.

In this study, the symbols for symptoms were designed to assist communication between health care providers and receivers. To evaluate the effectiveness of symbols for symptoms, the following two viewpoints need to be considered: (a) a provider-centered view of symbols as a one-way tool to collect information, and (b) a receiver-centered view of symbols as an interactive tool of communication. Generally, health care providers are busy and they try to assess the health status of the receivers as quickly as possible. For this reason, the symbols need to be equivalents and/or replacements of standard verbal expressions. Presently, 26 symbols for symptoms have been developed of which the first ten are understood by more than 90% of the members of the groups studied. Therefore, these ten symptoms seem to be suitable alternatives to verbal expression. However, because some groups showed less than 90% comprehension of the remaining 16 symbols, these symbols need further improvements to become useful alternatives to verbal expression, especially for use with people with a hearing impairment and limited literacy. As there are many more symptoms than those indicated by the 26 symbols, we are still at the earlier stage of the effective development of this instrument.

Health care receivers usually want more detailed communication with health care providers than is actually received. In the receiver-centered view, which has not been fully described in this paper, the pictorial presentations are expected to facilitate communication in the health care setting. In this study, subjects in the hearing impaired II and III groups actively responded to the graphic symbols regardless of their communication difficulties. In this setting, the use of graphic symbols facilitates communication between health care providers and receivers and promotes a better understanding of health status by both parties.

Increasingly, pictorial presentations have recently been used to communicate information. For example, special editions of a Japanese nursing journal have adopted the editorial strategy to popularize experts knowledge among beginners (Abe 1988; Kawano 1992), and for this purpose, a large number of illustrations and cartoon like drawings have been utilized. However, academic research using pictorial presentation of symptoms is scarce. Even in major medical journals, the illustrations are usually drawn by professional illustrators, and no cognitive rules or criteria appear to have been considered to present the medical symptoms. The graphic description of the quantitative aspects of pain is a welcome exception (Moll 1986; Wong and Baker 1988). In this present research, several cognitive strategies were newly obtained during the development and evaluation of symbols. In later studies, these strategies should be further employed to refine the instrument to improve communication in health-care settings.

There are potentially many different areas in which these types of symbols can be used. Not only people with hearing impairments but also those with normal hearing ability could benefit from the using graphic symbols. Since their

first use of graphic symbols in 1991, the authors have been trying to develop strategies for the use of graphic symbols for hearing impaired people in Japan and for headache patients in the USA, however, at present without complete success. There are still many unsolved difficulties apart from the development of the graphic symbols themselves. Some of these are the following:

1) To develop appropriate visual framework to use graphic symbols.

In order to write some meaningful sentence in any language, the writer needs to understand both the words and the grammar. This relationship between words and grammar also applies to the relationship between the graphic symbols and the rules to arrange the symbols. At this present, the authors have not yet fully determined the rules to arrange the symbols.

2) To popularize the graphic presentation of symptoms in the medical community.

Although there is a clear trend toward the use of graphic symbols, the majority of health care providers and receivers still consider cartoons as childish amusement and do not accept them as instruments of communication. Some health care providers still hesitate to translate their expert vocabulary into a simpler form, including cartoons. When such health care providers encounter the graphic presentation of symptoms, they are too critical to accept them. To increase the popularity of graphic symbols in the larger medical community, their successful use in particular areas needs to be documented.

3) To understand the cognitive processes of the respondents.

In the early stages of this research, the authors considered using graphic symbols to assist verbal communication. During further trials, however, the different cognitive processes for each of the respondents became evident. For example, when respondents were encouraged to externalize their perception of particular symptoms in a variety of ways, some respondents preferred verbal clues while others preferred visual clues. Of interest is that even respondents with the normal hearing ability show such differences in preference. If a respondent's dominant cognitive mode is visual, the graphic presentation of symptoms would have a greater value than for the respondents with verbal cognitive mode. The details of these case based observations are the topic for further studies to be published at a later date.

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