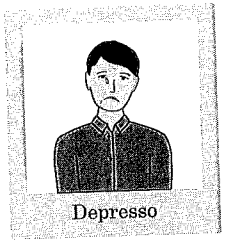
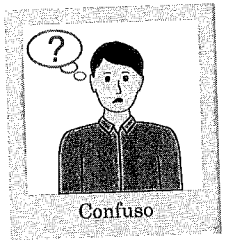
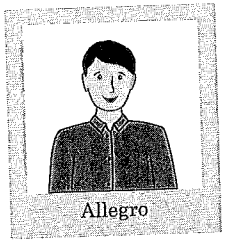


Depressed - 1/4



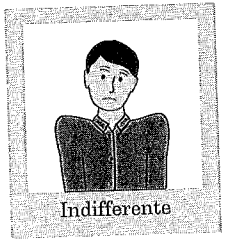
Confused - 4/4



Happy - 2/4

Tired - 1/4

Determined - 0/4



Indifferent - 0/4

line drawing - less easy

line and flat tone - easier

line and flat tone with red jacket for main character - easier

4 Designing a Visual Tool to Interview People with Communication Disabilities: *a user-centered approach*

Guillermina Noël

ABSTRACT

To design in collaboration with users, speaking and listening are essential. This article shows the process of interviewing people with a communication disability called aphasia. Aphasia is caused by brain damage and affects speaking, understanding speech, reading, and writing to some degree. The focus of the article is on the creation of visual tools to facilitate the understanding of questions and producing answers by people with aphasia. Everything has to be adapted to match their needs: the wording, the types of questions, the way a question is introduced, and the length of the interview, among other things. For every question, specific material was designed to facilitate communication between the person interviewing and the person with aphasia. The strategy was to combine verbal information (oral and written), pictorial information, and movement. The main goal of the interviews was to understand the feelings and opinions of people with aphasia regarding the diagnosis process. The interview results helped identify people's preferences regarding the context in which the assessment takes place, as well as their needs regarding the visual materials used. The project demonstrated that it is possible and valuable to apply a user-centred design approach to the design of the visual material used to assess aphasia.

KEYWORDS

interviewing; communication disabilities; aphasia; user-centerer design; visual tools to facilitate understanding; collecting opinions; identifying feelings; outline only; line and tone; and color images; checking assumptions; object recognition

TRODUCTION

In face-to-face interviews, talking is the main tool for getting people's perspective and opinions about a subject. Hammersley and Atkinson (cited in Legard, Keegan, & Ward, 2003, p. 138) stated:

> The expressive power of language provides the most important resource for accounts. A crucial feature of language is its capacity to present descriptions, explanations, and evaluations of almost infinite variety about any aspect of the world, including itself.

Difficulty in producing or understanding language is a hallmark of aphasia, so it can be difficult to obtain these descriptions, explanations, and evaluations. It can also be difficult during the interview with people with aphasia to avoid making them feel frustrated and get tired. However, to gain insight into the patients' feelings and opinions regarding specific aspects of the assessment situation and to identify design possibilities, it was fundamental to interview patients.

In the aphasia literature, a clear need appears to use every possible avenue to obtain the necessary information. "The aim of an …interview is to obtain as full and unbiased an account as possible of the participant's perspective on the research topic, and the researcher's task is to use every means at their disposal to aid this" (Legard, Keegan, & Ward, 2003, p. 158). Similarly, Luck and Rose (2007) stated "both the interviewer and participant may need to use particular strategies for a successful communication exchange" (p. 209). The interview had to be adapted and planned with the needs of people with aphasia at the centre. Several questions needed to be addressed: How to facilitate comprehension? How to avoid fatigue? How to reduce frustration? How to facilitate answering the questions? It was fundamental to work in close collaboration with a speech therapist. These points are addressed under the subtitle "Method."

ARTICIPANTS

The main selection criterion was people with aphasia who can understand brief questions, answer by pointing to images or saying 'yes' or 'no,' and read brief words. Since this research was conducted in Italy, participants needed to have Italian as first language. Age, gender, level of education, socio-economic level, and time post onset were not selection criteria.

Based on this, the speech therapist contacted people with aphasia who met these requirements, and she had a brief conversation with them, by phone or personally. The goal of the conversation was to inform possible participants about the project. The possible participant was asked if she/he would be willing to contribute to the project participating in an interview about different factors that could affect the assessment.

Three men and two women agreed to participate. Initially the intention was to interview seven patients, but time constraints and availability of patients made it difficult to arrive at this number; at the end five patients were interviewed. It is assumed that using sets of five users will reveal about 80% of all the problems in the design (Nielsen, 2000). This information will allow improving the design and eventually re-evaluating it with five other participants.

METHOD

The interviews have two main goals: a) to collect opinions about feelings of people with aphasia during the test, about interruptions during the test, and about preferences regarding the space and test length, and b) to evaluate the performance of black outline-only drawings and colour drawings to identify fruits and to evaluate the performance of black outline-only drawings, line and tone, and colour to identify characters in a scene (most aphasia tests, regardless of the type of task to perform, use black outline-only drawings).

The interviews were developed in the Department of Neurology at the University Hospital of Padua, and approval was obtained from the Director of Clinical Neurology I.

A legal requirement of the hospital was that the interviews had to be performed by the speech therapist, but I was allowed to sit in and observe the interviews. This allowed me to observe the situation, take notes, and assist the therapist during the interview, organizing and handling the necessary materials. I prepared an interview plan to guide the speech therapist during the interview process (see *Figure 1*).

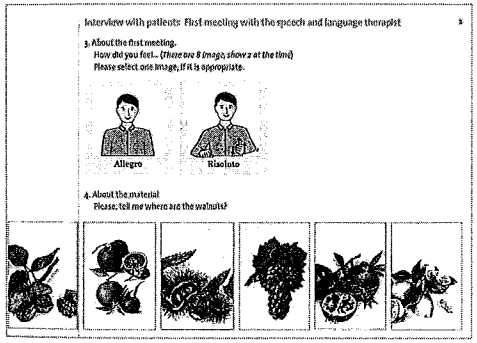


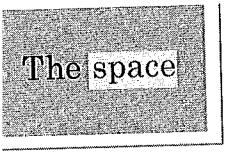
FIGURE 1

The interview opened with a brief account by the therapist about the "first meeting with the speech therapist." It was decided to talk about the "first meeting with the therapist" rather than the assessment or diagnosis of aphasia. The phrase "assessment of aphasia" was considered jargon. Open questions (such as: could you please describe how were you feeling during the assessment?) were considered as not appropriate, since this type of question would present difficulties to some people with aphasia. It was chosen instead to ask brief and concrete questions (for example, Do you prefer a space similar to a regular office or to a doctor's office?). Every question was introduced by the topic (for example, "about the space" or "about the material") and followed by the specific questions.

Interviews were individual. For every question, visual material was designed to support communication, to facilitate understanding of the question, and to answer by pointing. The visual material

created a common territory for the person with aphasia, the speech therapist, and myself. It anchored the topic of the question; as Barthes (1977) explained, "[it] helps me to choose the correct level of perception, permits me to focus not simply my gaze but also my understanding" (p. 39).

Questions 1, 3, 5, 6, 7 and *9* presented a series of options, and the participant indicated which option s/he preferred. The therapist introduced the topic verbally and then presented the topic in a visual modality, a 10.5 x 7 cm card (see *Figure 2*). The typeface used was Century Schoolbook. The x-height of the lower case is 6 mm. The interview used a combination of verbal information, pictorial information and movement. Next, the procedure followed for each of these questions is described.



IGURE 2

Question 1 - About the space: two images were created (see *Figure 3*). These images communicated two concepts: a) the first meeting of the therapist and the patient, and b) the type of space. The first concept is represented by colour photography, the second in black outline drawing. The size of each image is A3 (tabloid). The images were presented side-by-side, and the person with aphasia had to point to the one s/he preferred. The speech therapist asked, "Do you prefer a space similar to a regular office or similar to a doctor's office?" When naming "an office" the speech therapist pointed to the image of the office; when naming "a doctor's office" she pointed to the corresponding image.

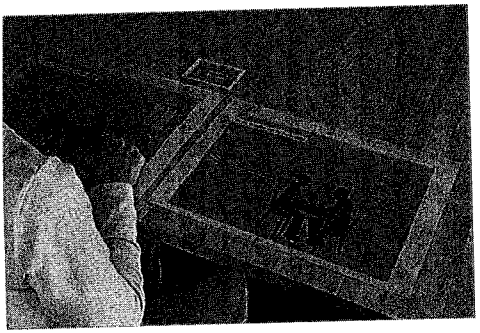


FIGURE 3

Question 3 - About the patient's feelings: eight images were created to communicate different feelings. Initially colour photographs were used, and some "feelings" such as "nervous" were not clear (see *Figure 4a*). Consequently, the "feelings" were communicated through drawings. Drawings allowed features of the image to be exaggerated to avoid ambiguity. For example, adding a wavy outline to the arm of the character to communicate nervousness (see *Figure 4b*). The drawing style is line and flat tone (8.5 x 9 cm). Two "feeling" images were shown side by side (see *Figure 5*). The speech therapist asked: during the assessment did you feel…(for example confused or determined)? As in the previous question the therapist pointed to the image while naming the corresponding feeling. The therapist explained to the participant, to select one, two, or none. The image was selected by pointing.

Question 5 - About the length of the meeting: a set of images was created for this question (see *Figure 6*). The therapist placed the topic card and a colour photograph of a clock to communicate the idea of time. Then she placed four rectangles, each with a different time option: 1 hour, half an hour, 20 minutes, 10 minutes. Then she asked "Did you prefer to work for an hour and then take a break, half an hour and then take a break…" while placing the word "break" between, for example, the hour and the half an hour option. A man relaxing on an armchair communicated the

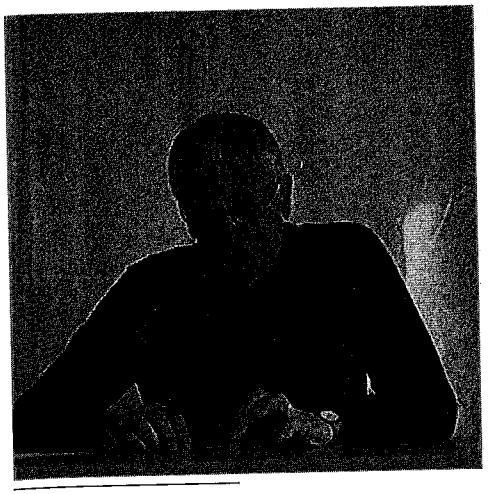


FIGURE 4A

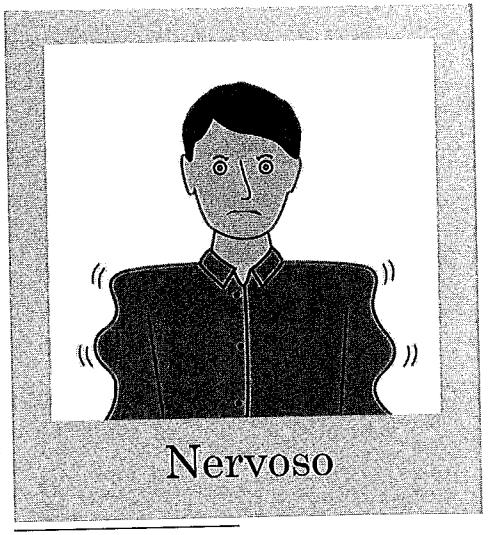


FIGURE 4B

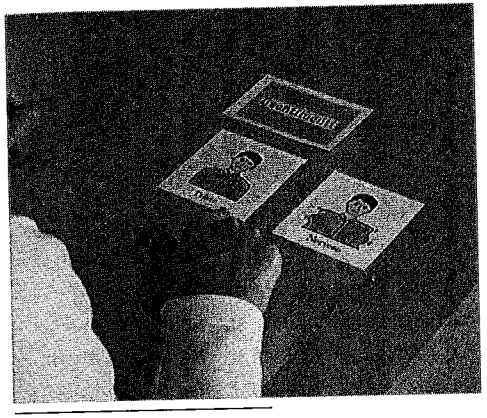


FIGURE 5

concept of taking a break. The person with aphasia indicated her/his preference by pointing.

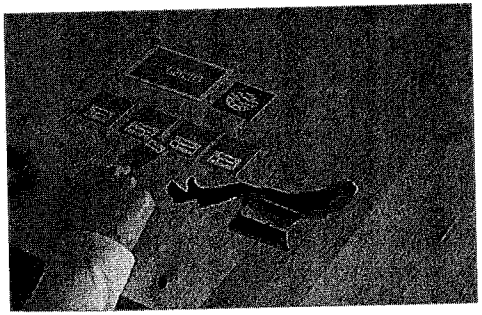


FIGURE 6

Question 7 - About interruptions: the same image used to communicate the concept of the "meeting with the therapist" in Question 1 was used here. A silhouette of a lady bringing a paper was added to this image. Two images to communicate "yes" and "no" (see *Figure 7*) were used to facilitate answering the first part of the question: "If there were interruptions during the meeting. Did the interruptions disturb you?" If "yes," the therapist showed a three step rating scale – nothing, a little, a lot – and asked: "How much did the interruptions disturb you?" If necessary, the person answered by pointing.

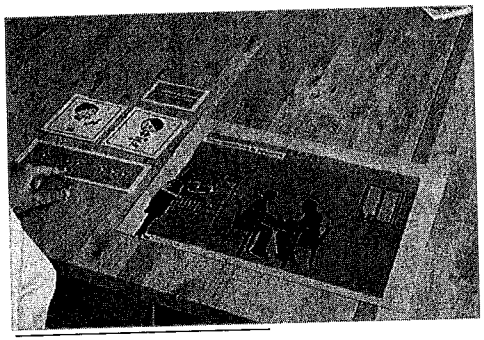


FIGURE 7

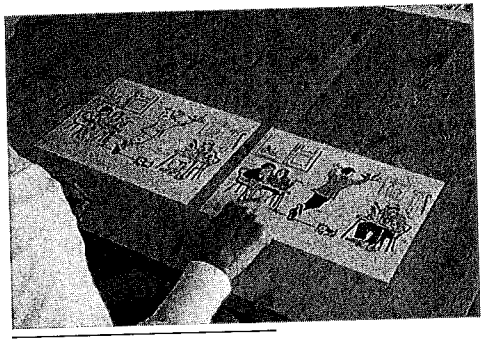


FIGURE 8A

FIGURE 8B

Questions 6 and 9 explored the performance of three different drawing styles: a) black outline, b) line and flat tonal value for the characters, and c) line and flat tonal value for the characters with a red accent for the jacket of the central character (see *Figures 8a & 8b*). The image shows a scene in a coffee-shop, the size of the images is A4 (letter size for North American readers). In *Question 6,* the speech therapist placed the black outline and the line and tone drawings side by side, and asked: "in which of these two drawings is it easier to recognize the dog?" The participant pointed at the image s/he found easier.

In *Question 9,* the therapist placed side by side the line and tone, and the line, tone and red accent drawings. Then she asked: "In which of these two drawings is it easier to identify the lady smoking?" The person with aphasia pointed at the image s/he found easier.

Questions 2, 4, 8, and 10 evaluated the appropriateness of the visual material to perform different tasks.

Questions 2 and 4 explored the performance of black outline and colour drawings when identifying fruits (see *Figure 9a & 9b*). It was explained that we were studying the adequacy of the material, not the person's ability to recognize the image. The therapist placed seven images (7 x 10.5 cm) in a row and said: "I ask you to perform a task. Please

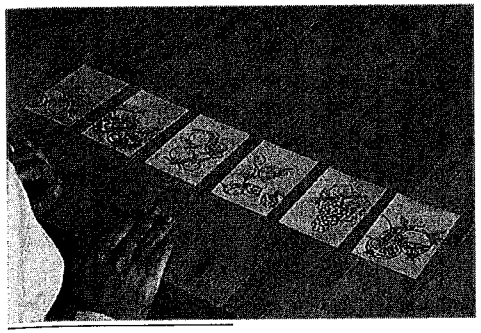


FIGURE 9A

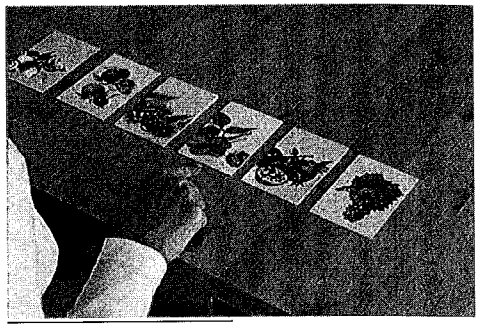


FIGURE 9B

tell me where are the walnuts" (at other times the picture to identify was the oranges). For Question 2 the images were black outline drawings, for Question 4 the images were colour drawings. The number of images was chosen to avoid overloading visual processing capacity (Miller, 1994). Time to find the right image was measured with a chronometer that the patient couldn't see. Questions 8 and 10 are not reported in this article.

DATA ANALYSIS

For questions 1, 3, 5, 6, 7, and 9, each response was recorded with an X on the interview plan set. A set was printed for each patient. The responses were grouped according to choices. In many cases a table was designed to facilitate analysing and reporting the findings.

For questions 2 and 4, times were recorded, totals were added and difference in performance between the two conditions were noted.

FINDINGS

The interview had two main goals. The first goal was to collect the opinions of people with aphasia about the space where the assessment took place, their feelings during the assessment, their preferences regarding the length of the assessment, and their opinions about interruptions during the assessment. Questions 1, 3, 5 and 7 sought to collect this information, relying on visual material to facilitate communication.

A second goal of the interview was to evaluate the appropriateness of the visual material used to perform different assessment tasks. Questions 2, 4, 6, and 9 were developed for this purpose. The findings are presented according to the two groups of questions.

1. About the environment.

Do you prefer a space similar to a regular office or similar to a doctor's office?

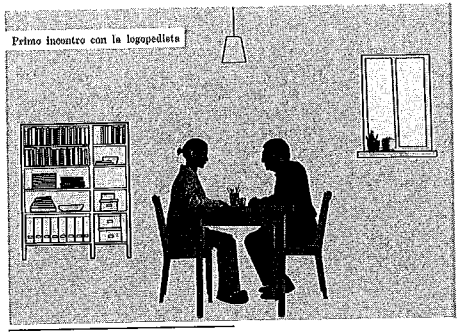


FIGURE 10

The five persons with aphasia selected the image representing the space similar to an office (see *Figure 10*). Participant 3 added: "With the office I feel a more normal rapport. Mentally better disposed. In the other [the doctor's office] I am a sick person." And person with aphasia 4 mentioned: "The doctor's office has a sick look."

3. About the first meeting.

How did you feel…?

Participants reported a combination of feelings experienced during the assessment (see *Table 1*). Consistently, all the participants said they were "confused." Three people reported being confused and nervous, and two people mentioned being confused and tired. Two participants said they were happy, and two indicated that they were sad or a little sad. Participant 1 reported: "I was shaking all over." And Participant 4 said: "I couldn't perceive the totality."

TABLE 1.
Feelings expressed by each person with aphasia interviewed

Participants	Depressed	Sad	Confused	Nervous	Happy	Tired	Determined	Indifferent	Angry
P.1	●	●	●	●					
P.2			●	●	●				
P.3			●		●	●			
P.4		●	●	●					

5. About the duration of the meeting.

Did you prefer to work for… (i.e., 1 hour and then a break, half an hour…)

The information (see *Table 2*) reveals that time preferences vary among people with aphasia. One person indicated that he prefers to work for 20 minutes; two other participants said that they prefer to work for half an hour. Participant 3 mentioned that he prefers to work for an hour but with a pause after 20-30 minutes of work. He said: "There is a need to build rapport. We are here to talk, talking can also be a break. A mental break." Participant 4 said that she could work for an hour without a break. Interestingly she mentioned: "It was not tiring, without a break, without anything. Speech therapy was not a heavy load, with physiotherapy yes. Serena [the speech therapist] is so nice."

TABLE 2.
Preferred time duration expressed by each person with aphasia interviewed

Participants	Preferred meeting duration
P.1	20 minutes
P.2	30 minutes
P.3	1 hour with a break after 20 - 30 minutes
P.4	1 hour without break
P.5	30 minutes

7. If there were interruptions during the meeting.

a). Did they disturb you? Yes - No? (if yes) b). How much did they disturb you?

Four of the five participants responded that the interruptions did not disturb them. Participant 1 indicated that he rested during the interruptions; and participant 3 said: "I took advantage and put the conversation into focus." Participant 4 mentioned: "I took advantage of the interruptions and rested." Participant 5 indicated that the interruptions disturbed him a little, because they distracted him.

2 & 4. About the material.

I will ask you to perform a task. Please, tell me where are the oranges/walnuts?

Table 3 summarizes the comparison between the performance time of patients using material in colour and using the material in line only.

TABLE 3.
Recognizing the orange: performance time with material in colour and in line

Participants	Color image	Line image
P.1	0.5 sec	2 sec Wrong answer: lemon
P.2	0.5 sec	23 sec
P.3	0.5 sec	1 sec
P.4	1 sec	1 sec
P.5	1.5 sec	4 sec
Totals	**4 sec**	**31 sec**
Totals (without P.2)	**3.5 sec**	**8 sec**

As can be seen in table 3, even without counting Participant 2, people with aphasia performed better when using the material in colour than when using the material in line. Even more relevant is the fact that people with aphasia did not make mistakes when using the material in colour. Participant 3 commented: "The hazelnuts are clearer in colour." Participant 4 mentioned: "With colour, the impact is immediate. The lemon is seen immediately."

TABLE 4.
Identifying the dog: ease using the material in line and in line and tone

Participants	Scene in line	Scene in line and tone
P.1		Easier
P.2		Easier
P.3		Easier
P.4		Easier
P.5		Easier

6. About the material. In which of these 2 images is easier to recognize the dog?

Table 4 shows the opinions of people with aphasia regarding the ease of identifying an object comparing a scene presented in line with a scene presented in line and tone.

There was a consistent agreement that it was

easier to recognize the dog when the scene was presented in line and tone.

9. In which of these 2 images is it easier to identify the lady smoking?

Four out of five people with aphasia reported that there was no difference between recognizing the lady smoking in a drawing using tone as well as line and in a drawing using tone and colour. Only Participant 1 found it easier to recognize the lady smoking in the line and tone drawing than in the tone and colour drawing. Participant 3 added: "There are no differences. Colour is not disturbing. I look at the whole and then the specific. If I am searching something I go to the specific. It depends on the attention."

The interviews with people with aphasia provided very valuable insights, such as that the identification of characters in a scene is facilitated by the use of tone, and that some patients take advantage during the interruptions to rest or think about the task they were performing. This new information can help generate ideas for the improvement of the material. These findings are discussed in detail in the discussion.

DISCUSSION OF FINDINGS

The objective of this discussion is to integrate the main findings to get to a comprehensive perception of the results and identify future research directions. The findings are discussed by themes.

FINDING 1: DIFFERENT PEOPLE HAVE DIFFERENT FEELINGS

The interviews with people with aphasia showed that the way patients feel varies from person to person. The five people with aphasia who were interviewed reported different feelings; however, all of them mentioned being confused. In the feelings that people with aphasia mentioned, there was always a combination of feeling confused and tired, or confused and nervous. What did not emerge during the research are the sources for this confusion: if it is circumstances encountered during the situation of the assessment that cause it, or if it is the aphasia itself that causes the confusion. Holland (2007) on people with aphasia confusions stated, "Particularly if they buy into 'rehabilitation magic' and are bewildered by 'rehabilitation mystery,' both aphasic persons and their family members may very well feel uninformed and confused" (p. 173). Further research is needed to identify what caused confusion and to reduce this feeling as much as possible so that patients can perform at an optimum level.

FINDING 2: INTERRUPTIONS CAN BE AN ADVANTAGE FOR PEOPLE WITH APHASIA

During a series of observations I performed previously, I identified that nurses, doctors, colleagues, and phone calls frequently interrupted the

assessment. Interestingly, in the interviews with people with aphasia, they reported that the interruptions did not disturb them. People with aphasia reported that they take advantage of interruptions and rest. As Participant 3 stated: "I took advantage and put the conversation into focus." The fact that people with aphasia take advantage of the interruptions has important methodological implications. It also proves the value of checking the most obvious assumptions we make by consulting with people with aphasia.

FINDING 3: THE ENVIRONMENT'S APPEARANCE MIGHT INFLUENCE RECOVERY

The assessment environment must be created by attending to the psychological needs of people with aphasia. The environment's appearance affects the process of recovery (Ulrich, 1991).

I asked people with aphasia if they preferred an environment similar to an ordinary office or a doctor's office. The five people with aphasia interviewed responded that they preferred a space similar to an ordinary office, since 'the doctor's office makes you feel ill.' An environment that makes people with aphasia feel ill undermines recovery. There is a need for a room specially created for aphasia assessment and therapy. The room must be conceived as a working space that allows flexibility to the therapist adapting it to different needs.

FINDING 4: MOTIVATION PLAYS A ROLE IN TEST LENGTH PREFERENCES AND ATTENTION SPAN

Mental fatigue affects attention, an essential skill in information processing. Attention allows the selection of relevant information to perform a task. When people are tired, they select both relevant and irrelevant information to process, causing further difficulties (Boksem, Meijman, & Lorist, 2005).

Most of the people interviewed reported that between 20 and 30 minutes was the ideal time length for the test. Two people mentioned that it could also be an hour, explaining that a) there is a need to build rapport and this takes time, and b) given that the therapist was so nice, it was not an effort to work for an hour, unlike the case of physiotherapy. This information shows that the problem of sustaining attention is not exclusively cognitive; it is affected by motivation, which partly depends on the therapist's ability to engage with the person with aphasia. Research is needed to identify if the visual material and its topic could also affect motivation.

FINDING 5: USING TONE FACILITATES IDENTIFICATION OF CHARACTERS IN SCENE DESCRIPTION

Scene description provides information about different aspects of language such as the use of grammar, the number of words produced, type and amount of content provided, and subject and organization of discourse. This

information provides different perspectives about speech (Mackenzie, Brady, Norrie, & Poedjianto, 2007). To perform the task, the therapist shows a scene (A4 or letter size) to the patient and then says: "Tell or describe everything you see going on in the picture." Images used for scene description are usually black line drawings. All the lines have the same thickness.

The use of an image when assessing verbal production is indispensable. It provides "a consistent referent… and memory and sustained attention demands are minimized" (Mackenzie, Brady, Norrie, & Poedjianto, 2007, p. 341).

As already mentioned, I created a scene in three different visual appearances (A4 format). One scene is black line drawing, a second has line and flat tonal value only for the characters, and a third has also line and tonal value for the characters with a red accent in the jacket of the main character. It was assumed that adding tone to the characters could segregate these from the background thus facilitating their visual recognition (Koffka, 1955). The three scenes were shown to people with aphasia. First, the line drawing and the line and tone drawing were presented. I asked in which of the two alternatives was it easier to recognize the dog (Figure 8a). All the participants chose the line and tone drawing. After doing other tasks, the line and tone drawing was presented side by side to the line, tone and red accent drawing. Each person with aphasia was asked in which of the two options was it easier to identify the lady smoking. Most participants indicated that there were no differences between the two.

These results are promising, showing that adding tone to line drawings might facilitate the identification of the characters performing the actions.

FINDING 6: COLOUR PLAYS A ROLE IN OBJECT RECOGNITION AND CAN REDUCE CONFUSIONS

As previously mentioned, only shape is used to communicate the object. While shape provides efficient information when recognizing an object (Biederman, 1987), adding information to the image, such as adding colour, might facilitate the recognition of objects.

> For example, when shopping for fruit, 'yellow' is an important cue for differentiating lemons from limes, but yellow would not be critical for selecting lemons from pineapples. Thus, shape and color interact; color facilitates recognition of objects within structurally similar categories (e.g. animals, birds), but not necessarily structurally dissimilar categories (e.g. body parts, musical instruments, tools).
> (Tanaka, Weiskoptf, & Williams, 2001, p. 212)

During the interviews I asked people with aphasia to perform two tasks to identify the role of colour in the recognition of fruits. In the first task, I asked

people with aphasia to indicate where was "the orange" or "the walnuts." They had to recognize the picture among seven black line drawings, and among seven colour drawings. The seven images were displayed in a row. The order of presentation changed; some people saw first the outline images then the colour ones and others saw them the other way around (see *Figures 9a & 9b*).

Responses were faster for images in colour than in black line, despite the differences between individuals, and regardless the order of presentation. The average time to recognize the picture in colour was 0.8 seconds, and in line was 6.2 seconds. One of the participants tilted the results, taking 23 seconds in the line condition. But even without this participant the responses are faster for images in colour, with an average time 0.875 seconds in colour versus 2 seconds in line. Most important, a participant looking at the black line drawing pointed to the lemon instead of to the orange. These results are similar to those reported by Rossion and Pourtois (2004), where the addition of colour speeded up naming responses particularly for the categories of fruits and vegetables.

This data suggest that adding colour could not only reduce the time to recognize the image, but it could also help reduce opportunities for confusions and errors. The above discussion supports the need to further investigate this problem.

It was also identified that sometimes, when looking for the right fruit, showing seven images in a row might not be adequate. Depending on the number of pictures presented, the task becomes a search-and-find task rather than a matching task. When the number of pictures increases, the time to point to the right image also increases. Fisk and Schneider (1983) reported studies indicating, "reaction time performance is a linear function of memory set size (i.e., the number of items in memory to be compared)" (p. 178). Accuracy on visual search tasks depends on the number of items and on the similarity among them (Eriksen & Schultz, 1979). Image-laden material overloads the working memory of people with aphasia, and this might decrease performance. Kirschner (2002) stated: "Working memory load is affected by the inherent nature of the material and by the manner in which the material is presented" (p. 4). The design of the visual material must be user and task appropriate. The increment in cognitive load might lead to errors that are due to the inappropriate design of the materials, rather than to aphasia. The material might influence assessment accuracy. Research is needed to determine the optimum number of pictures to present in word-picture matching tasks.

LIMITATIONS AND CONCLUSIONS

A main limitation is the number of participants. More work is needed to determine for what type of object categories colour plays a significant role, and for what type of patients adding colour is effective. Research is needed con-

cerning how to reduce undesirable cognitive load caused by the material.

Despite the fact that many assessment tasks use images, their impact on the answers from people with aphasia is underestimated or misinterpreted. Several problems need careful attention, such as the number of images presented. There is a variety of wrong assumptions. Simplifying the image does not lead to a facilitation of its recognition. Line drawings are not clear enough. The material must be created according to the task to perform, the users' needs and limitations, and the situation of use. The material has the potential to engage the patient in the assessment activities, to facilitate sustaining attention, and to make assessment less tiring and more pleasant.

Aphasia experts (therapists and patients) and visual communication designers (with the required knowledge and understanding of perception, cognition, and aphasia) must work in collaboration to improve the material. The material can facilitate the therapist's task by reducing confusion and the need for additional explanations. It also has the potential to engage the patient in the assessment activities, to facilitate sustained attention, and to make assessment less tiring and more pleasant.

The material needs to be designed with therapists and patients at the centre and to facilitate the patients' engagement in the assessment activity. This research indicates that the evaluation of the visual material by people with aphasia helps identify and reduce problems. This can certainly lead to an improvement in the quality of materials.

The interviews showed the need to work in partnership with people with aphasia and that visual communication design can make a significant contribution by designing interview tools, 1) to help them to understand what is said, and 2) to answer by speaking or pointing when speaking is not possible.

This methodology and these results were used to inform two other studies: one aimed at arriving at a set of words that are relevant to the person with aphasia, allowing the therapist and the person with aphasia to identify reading comprehension difficulties and possible ways to reduce them, and presenting possibilities for a clear visual representation. A second study aimed at understanding what aspects of the visualization can facilitate the essential processing of the material, aspects that create barriers, aspects of the activity that promote active processing of the information, methods to reduce unnecessary cognitive processing, and methods to create word-picture matching material that is sensitive to cognitive abilities and limitations of people with aphasia.

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AUTHOR

Guillermina Noël

Guillermina Noël holds a PhD in Design Sciences from the University IUAV of Venice, Italy, and a Master of Design from the University of Alberta, Canada. She has worked on the design of materials for people with severe speech and reading impairments, interacting with neurologists, educational psychologists, and speech therapists, emphasizing the importance of user-centered design and design for users with special needs. She has participated in conferences and delivered lectures and workshops in Argentina, Italy, Switzerland, Brazil, Canada, USA, Colombia, Paraguay, Sweden, Spain, Cuba and Mexico. She has taught design at the University of La Plata, at the University of Alberta, at the University of La Matanza, and at the Universidad de las Americas Puebla, and works professionally in visual communication design since 1997. Since 2003 her practice focuses on health related design issues. She is now an Adjunct Researcher at the Health Design Lab at Emily Carr University, Vancouver, Canada.