

An Online Multimedia Language Assistant for People with Aphasia and Other Language Barriers

Xiaojuan Ma
Princeton University
35 Olden Street
Princeton, NJ 08544
xm@cs.princeton.edu

ABSTRACT

Individuals with aphasia, a language disorder, are seldom able to utilize the Internet as a source of information, because their disability makes many written words incomprehensible. A similar situation exists for individuals who read and speak a second language but do not possess a vocabulary as extensive as in their native language. Pictures have been demonstrated to help in both cases. However, few existing paper or electronic picture dictionaries provide efficient, scalable, and adaptable support for looking up unknown terms encountered when browsing the web. For my thesis research, I am designing and developing an Online Multimedia Language Assistant, which allows a reader to click on an unknown word and receive interpretations of the word in as many as five different multimedia representations. The system provides a popup dictionary, images, animations and audio, where applicable. It is also adaptable (by user) and adaptive (system).

Keywords: Multimedia language, visual communication, aphasia, second language, medical care, cooking.

1. INTRODUCTION

The Internet is a rich source of information today, and yet, most of its information is given in written form. For individuals with aphasia, an inability to comprehend text, as a result of a stroke, brain tumor, or brain trauma, the Internet becomes inaccessible. Their language disorder makes it difficult for them to read complex words and associate them with meaningful concepts. Even if an aphasic can recognize individual words, he or she may have problems understanding a more complex phrase.

Guidelines exist for creating aphasia friendly websites by increasing the readability of the web (font size, spacing, etc.). The use of pictures as an aid has been recommended since people with aphasia tend to retain their ability to comprehend images and animations [6]. However, little research has actually been done on improving individuals with aphasia's understanding of web content. Systems have been built using pictorial or auditory materials to support an aphasic in building communications, such as Augmentative and Alternative Communication (AAC) devices (e.g. Lingraphica [2] and ESI-Planner II [1]), but none support web use.

For my dissertation research, I am building an Online Multimedia Language Assistant system that helps users (people with aphasia) to instantly look up multimedia representations of words by clicking on the unfamiliar word and/or to select concepts represented by images in an adaptively organized dictionary that translates the user's intent into written or spoken communication. Users can also add their own pictures, videos, and audio clips, and thus, personalize the language assistant to fit their needs. The system's media organization is adaptive and based on usage updates and user profiles. The focus of the Online Multimedia Language Assistant system is to provide multimedia cues as a supplement to verbal texts to

enhance comprehension of words in context, and how to enlarge the white space and font size in a webpage to make it aphasia-friendly is not part of the work.

The Online Multimedia Language Assistant differs from other communication/language support systems in three main aspects. First, vocabularies of most systems (i.e., Lingraphica) contain mainly images, icons, and speech audio (pronunciations of the words). Other visual and audio stimuli are under-exploited. The system I am building also incorporates videos and environmental sounds to support concept illustration and communication. Second, few AAC devices target the enhancement of an aphasic's comprehension of online information. Pictorial Internet dictionaries (e.g., [4] and [5]), which are designed for cross-language translation, are implemented as separate websites and require switching between web pages when people look up an unknown word. This presents two problems, one of context switching in opening a new web site, and second, the loss of the context in which the word is being used. The multimedia language assistant uses a browser extension which avoids the context switching and additional manipulation. Third, current pictorial dictionaries are typically created by designers. They provide one or two efficacy-untested pictures to demonstrate a concept. This form of image generation does not scale well, that is, adding additional domains of interest and multiple variations of images is time consuming and expensive. The multimedia language assistant provides mechanisms for user contribution of new multimedia data to expand and personalize the vocabulary.

The ultimate goal of my research is to help people who have aphasia. Our target group is those who still maintain a small vocabulary of simple words but have trouble understand more complex information in context. However, it is very difficult to conduct studies with the target population during the development stage of the system. First, it is challenging to communicate with individuals who have considerable language disabilities. Any portion of the participatory design, such as explaining system operations, conducting user studies, and gathering user feedback can introduce errors as a result of miscommunications. Second, it is inappropriate to load some of the problems that occur with the early development stages of a system on this set of people who already have considerable struggles with daily life. Third, systems designed for aphasic individuals have to be aphasia-friendly. With early prototypes, it is hard to differentiate problems that arise as a comprehension failure or an interface design flaw.

Therefore for many of our studies, we take the aphorism that "everyone is disabled in some situation" and applied the language disability issue that aphasics face to a second population, those people who use English as a second language. For people who live, work, or study in a second language environment, the language barrier can be frustrating and similar to the problems people with aphasia encounter in daily life. Even with the global access of the Internet and its abundant information, non-native speakers seeking domain specific information may incur difficulties. I will therefore first test the system on individuals for whom English is a second-language.

There are some issues with using non-native English speakers. In particular, they have such high verbal abilities that multimedia representations of concepts might be a hindrance rather than a help for them. This has to be tested before we can readily conclude that these people make good substitutes on which to evaluate our multimedia translation system. We propose to get around their ability to look up words in English to native language dictionary by selecting cooking and medical care as test scenarios. These are common domains in which non-native speakers run into problems, and in which the terminologies in the source language may not have direct translations to their own language. Even if they do, people may not know the words

in their own language. If the multimedia language assistant turns out to be useful for this type of user support, it also increases the marketability of the system, making it a less expensive choice for people with aphasia.

2. THE ASSISTANT'S WEB INTERFACE

Different web interfaces have been designed for the different functions provided by the Online Multimedia Language Assistant. For the main function, an instant multimedia dictionary, a web browser extension has been implemented, in which a small pop-up window presents the assigned multimedia representation when a word is selected by the pointer on a web page. Other web services provided include a search engine into the backend library, a viewer of the taxonomy of the vocabulary organization, and a platform for users to upload and share new multimedia data for concepts, as well as rate existing data. Having all the data and services online means that people can access the language assistant from any device with an Internet connection. Thus, problems with AAC devices such as portability, storage limitations, and synchronization constraints are removed.

3. RESEARCH PROBLEM AND EXPERIMENT DESCRIPTIONS

The multimedia language assistant is being built on the premise that multimedia enhanced web content is easier to comprehend than pure text enhancement. This premise has not yet been verified although we have tested the efficacy of different multimedia stimuli in conveying concepts using individual words and in the context of building short commonly used phrases.

To test out this premise, two experiments are being run, one in the cooking domain and the other in medical care. Each study is designed to target different visual representations according to the characteristics of the domain with the hypothesis that pictorial representations can enhance language comprehension for people using English as a second language, and by extrapolation, people with aphasia. Realistic photos are used for cooking, while iconic illustrations and animations are used for medical care which often needs animation for comprehension and also a consideration of the sensitivity of the subject matter in different cultures. In the food experiment, subjects are asked to select a named dish from a set of pictures. In the medical experiment, subjects must select over the counter medicines to fix a medical problem. Text only descriptions are compared to text supplemented with pictures to determine if the pictures enhance the comprehension.

4. RESEARCH STATUS

The Online Multimedia Language Assistant system has been implemented, and the initial vocabulary for the system installed. It is based on the vocabulary used in Lingraphica [2] and statistics on word usage frequency in daily conversations. Data collection, assignment and evaluation of web images, icons, animations, videos and non-speech audios have been completed. The web interface as a FireFox extension is available at <http://soundnet.cs.princeton.edu/OMLA/dict/firefox/download/>.

Experiments on the food and medication domains to evaluate the power of pictorial representations in web content comprehension for English as a second language individuals have been designed, piloted and are ready to be run.

Another aspect to explore is the balance between that static content of the OMLA database and the dynamic changes introduced by the adaptive features of the system. People with aphasia have already had difficulty in learning a new technology. The automatic change of the vocabulary organization and selection of effective multimedia representations which aims

to promote the efficiency of the system may simply introduce confusion. Thus, in the initial testing stage, the adaptive features are disabled. Later, once the system is modified and proved to be accessible to people with aphasia, an option will be provided to the users whenever there is an automatic adjustment in the system asking if they would like to accept the update or keep the current setting.

Ongoing and future work includes: 1) conducting the efficacy experiments with non-native English speakers; 2) testing the integrated multimedia language assistant system with non-native English Speakers; 3) modifying the system accordingly and evaluating the final system with people with aphasia; 4) analyzing and writing up the results.

5. ENVISIONED CONTRIBUTION

The Online Multimedia Language Assistant will be the first adaptive system that supports individuals in need of multimedia to understand and use written language available through commonly used browsers. It can support people with aphasia in more easily retrieving information from the Internet and in communicating via the Internet. In a broader scope, people with language barrier problems are also likely to benefit from this system.

REFERENCES

- [1] Boyd-Graber, J., Nikolova, S., Moffatt, K., Kin, K., Lee, J., Mackey, L., Tremaine, M., and Klawe, M. Participatory design with proxies: Developing a desktop-PDA system to support people with aphasia. In Proc. CHI 2006, 151–160. ACM Press, 2006.
- [2] Lingraphica. <http://www.lingraphicare.com/>. 2005
- [3] Ma, X. and Cook, P. How Well do Visual Verbs Work in Daily Communication for Young and Old Adults? In Proc. CHI 2009, ACM Press, 2009
- [4] Internet picture dictionary. <http://www.pdictionary.com>.2008.
- [5] pidic.com. Picture dictionary. <http://www.pidic.com>. 2008.
- [6] Thorburn, L., Newhoff, M., and Rubin, S. Ability of Subjects with Aphasia to Visually Analyze Written Language, Pantomime, and Iconographic Symbols. American Journal of Speech Language Pathology, 4(4): 174-179, 1995.