An Exploratory System to Teach English as a Second Language to Deaf Students with ASL Competency

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Program Area
Intelligent Interactive Systems for Persons with Disabilities

Keywords
Computer Aided Language Learning, Second Language Acquisition, User Modeling, Written English, Deafness, Natural Language Processing

Project Summary
The overall goal of this work is to develop a writing tool for native users of American Sign Language (ASL). Envisioned is a computer system that will take a piece of text written by a deaf user, analyze that text for errors, engage that user in a tutorial dialogue, and generate appropriate corrections to the text.

Our preliminary work in this area has included an analysis of writing samples from deaf ASL natives. The initial analysis has revealed that many of the errors (up to 75%) can be attributed to transfer from ASL to English. Because of this, it is hypothesized that a writing tool which takes advantage of ASL knowledge and views English as a second language may be beneficial. A novel aspect of this work is that our analysis suggests that transfer may not only account for a large percentage of sentence level errors, but might also explain some discourse problems. That is, there is evidence that writers may be carrying over discourse structuring and cohesion strategies from ASL to English. Part of the work proposed here will investigate how discourse errors can be detected and corrected in a computer system. We will concentrate on errors involving reference to items previously introduced in the discourse.

If the system is going to be "user-friendly," feedback should be tailored to the needs, preferences, and abilities of each individual user. This will involve deciding which errors to focus on and how they should be corrected. Efforts in this area will be guided by current results from Natural Language Generation, Second Language Learning, and Educational Assessment. The tool must also be able to adapt to a user – that is, change strategies as the user improves or as it becomes clear that the chosen strategy is not working. A major contribution of this work will be in the area of a corrective response generator. Primary emphasis will be given to tailoring responses to the level of English acquisition of the user.

The system will be evaluated and enhanced through a series of pilot tests with deaf writers. The design of the system will be such that various kinds of corrections can be tested with various user groups. For instance, we might compare the effectiveness of the system when it takes advantage of ASL knowledge in formulating a correction vs when it does not.

Anticipated benefits of the effort (in addition to the knowledge gained from developing the proposed computer assisted language learning system) include a linguistically motivated user model which captures stages in second language acquisition, and a sentence generator which can tailor its responses to these various levels. Because of the flexible design of the system, the resulting system has great potential benefit to the area of second language acquisition (both computer aided and not) because it can serve as a test bed for the testing of various correction strategies.

Project References
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Area Background

The work in this project is multi-disciplinary, and I will briefly attempt to introduce several relevant disciplines. My major area of research is Natural Language Processing where I have an emphasis on Natural Language Generation. Generation is a problem of choice – in Natural Language Generation emphasis is on discovering the parameters on which various necessary choices are based. In contrast is the area of Natural Language Understanding. Both generation and understanding are centered on the same subject matter – i.e., discovering ways to capture and exploit the various consistencies that one sees in a natural language such as English. Thus both areas must be concerned with various aspects of language: its syntax (the way words can be put together to form sentences in the language), semantics (the way the meaning of a sentence can be determined from the meanings of its individual pieces) and pragmatics (the way the intended meaning of a sentence can be determined from its semantic meaning and the context in which it was spoken/written). Though the subject matter is the same in generation and understanding, the emphasis is different. For example, one may be able to understand a sentence without explicitly understanding its syntactic form, but syntactic form is crucial in generation. In a similar way, one could understand a sentence which uses a particular syntactic construction (e.g., passive form) but if one is to appropriately generate, one must understand why a passive construction is appropriate in some circumstances and not in others. A similar argument can be made for coherence/cohesion factors. In understanding one can generally ignore the coherence of a text assuming that what is given is well-formed (and coherent). In generation one must determine what makes a text coherent and exploit those factors in a reasonable way.

At first glance it may not be obvious how this particular project relates to Natural Language Generation. However, emphasis on this project includes: (1) determining when a writer is using language appropriately – not only when constructions are used correctly, but when the discourse level of the text is appropriate. Thus the standard assumptions in understanding (e.g., that the input is a well formed and coherent text) cannot be followed. The system must understand how coherence is realized. (2) a large part of this project is aimed at determining *why* errors found in deaf writing are made. We look for the reasons behind the choices made (e.g., one reason might be a mismatch in the way a particular language feature is expressed between American Sign Language (ASL) and English). (3) part of the project has a standard emphasis on generation, especially with respect to the response generation. We hope to develop a generator which can tailor its syntactic choices to include choices the user is "ready to acquire", for example.

Other areas of research that are of particular importance for this project are the areas of user modeling, second language acquisition, and human computer interaction. User modeling investigates ways of capturing important aspects of the user so that a system can respond appropriately and effectively to a user. In this project we tie work in user modeling to the field of second language acquisition since the level of acquisition of English must be recognized by the system in order for it to respond appropriately. In addition, aspects of human/computer interaction must be understood in order to develop an interface which facilitates the interaction between the system and the user.

A final area of work to which this project relates involves applying AI technologies to various disabilities. Written English acquisition poses a tremendous problem for people who are deaf because they do not have the benefit of an auditory correlate to the words written on the page. In addition, their access to the English language is severely limited. While this avenue of research carries many potential gains to people who are deaf, it also carries tremendous potential for understanding human language and its acquisition. For example, in dealing with a signed language which utilizes simultaneous channels of communication (e.g., both facial expressions and "signs" on the hands) and which has no written counterpart, we have had to rethink standard questions such as how/why language transfer might manifest itself. Insights into such areas has great potential not only for people with disabilities but for all second language learners.

Area References

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Related Program Areas

Adaptive Human Interfaces.
Speech and Natural Language Understanding.

Potential Related Projects

Collaboration with projects in Machine Translation (where differences between two languages are emphasized) or in second language teaching would be beneficial.