ACES: Ruminations on Language Emulation Software

Joshua Hailpern
University of Illinois at Urbana Champaign
201 N Goodwin Ave
Urbana, IL USA
jhailpe2@cs.uiuc.edu

Marina Danilevsky
University of Illinois at Urbana Champaign
201 N Goodwin Ave
Urbana, IL USA
danilev1@illinois.edu

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Abstract

Receiving empathy and understanding is a constant need for those living with aphasia, an acquired language disorder that impairs expressive and receptive language (both spoken and written). With the introduction of ACES, a system that realistically emulates the effects of aphasia, we demonstrate how people can increase their empathy towards individuals aphasia, by experiencing the disorder firsthand. However, we believe that the true impact of our research on ACES goes beyond improving empathy for individuals with disorders. This paper outlines some of the directions we hope the HCI community will begin to explore by following the design of ACES and language emulation systems.

Keywords

Aphasia, Assistive Technology, Disabilities, Empathy, Emulation Software, Language, Speech

ACM Classification Keywords

K.4.2 Social Issues: Assistive technologies for persons with disabilities

Introduction

Spend a day in a wheelchair and develop an awareness of the challenges confronting a paraplegic [1]. Limit your communication to using only Augmentative and Alternative Communication (AAC) devices (such as text-to-speech systems) and see how the world treats individuals that cannot rely on their own vocal communication. By placing ourselves in the metaphorical "shoes" of others, we can gain empathy and understanding for others around us - a valuable achievement, since empathy is one of the fundamental underpinnings of interpersonal communication [2, 7]. If individuals relating to those with impairments lack empathy and understanding[1], it can greatly reduce quality of life [6].

In 2011, we introduced a novel system and model, **A**phasia **C**haracteristics **E**mulation **S**oftware (**ACES**), which allows users (e.g., caregivers, speech therapists and family) to experience the communication-distorting effects of aphasia firsthand. Through multiple experiments, we showed that ACES creates highly realistic distortions [5], improves empathy and knowledge of aphasia [4], and provides a platform for research in psychology, communication and language [3].

Yet the applications and implications of ACES reach far beyond aphasia. In this document, we present the broader use-model for language emulation systems. Further, we illustrate that language emulation is an interaction that can play a role in many types of interpersonal interaction as well as research contexts. We begin by briefly outlining the original ACES research, and then outline future ways in which the HCI community can grow this new area of technology.

[1] There is a difference between empathy and pity.

ACES

Based on feedback from a pilot study and the large body of related literature in Cognitive Psychology and Speech and Hearing Science, we created ACES, an IM client that uses a probabilistic model to distort IM messages sent by a user. Messages sent through ACES appear as though they were sent by an individual with aphasia [4]. Rather than seeking to imitate the whole disorder, we emulate specific distortions, thus creating a system that is 100% configurable by a user, and can emulate multiple types of aphasia.

To test the "realism" of ACES' distortions, we ran two variations of a Turing Test study in which participants were asked to distinguish samples of distorted text generated by a human from samples of text distorted by a computer. We chose Speech and Hearing Science students, faculty, and professionals as our participants because their training is specifically targeted towards the identification and treatment of speech disorders. Our results showed that participants could not differentiate between computer and human generated distortions and that both human and computer generated distortions appear equally "realistic" overall [5].

In order to observe the effects of using ACES on awareness and empathy, we conducted an in-depth user study. Sixty-four individuals (grouped in pairs) engaged in IM conversations with each other. We controlled for prior knowledge of aphasia (experts vs. general population) and presence of distortions (control vs. treatment group). The study showed that introducing ACES distortions increases empathy and awareness of aphasia (compared to a control group with no distortions.) Participants also outlined multiple uses for this system, regardless of prior experience with the disorder [4].

As a final exploration, we investigated the linguistic impact of ACES on conversation[2]. Through an experiment with 96 participants engaging in two 30-minute IM conversations (in pairs), we uncovered multiple impacts of ACES on language. For example, we have found that many of the linguistic changes that people employ mirror a known theory in the Psychology literature, Adaptation Theory. This suggests that ACES (and similar systems) can be used to explore communication theories in practice, and study the impact of therapeutic techniques designed to provide concrete changes to conversation patterns[3] We have also found that distortions have very different and uncorrelated effects on perceived and objective conversation quality, suggesting that improving conversation quality for individuals with aphasia may require a multidimensional solution [3].

Beyond ACES

Moving forward, there is much more for researchers in HCI, Psychology, and Communication to learn and test with a system like ACES. The system could have a huge impact in an educational setting (for therapists in training), therapeutic setting (to help family members adjust and empathize with an impaired family member) or even a critical care setting (preparing E.R. staff for interacting with stroke victims). However, we foresee additional broad directions that the HCI community should explore, based on the novel technology of ACES. These directions focus on emulating or modeling a disorder, and the impact such models can have on communication, therapy, and day-to-day interaction.

Anti-Distortion Systems

We believe that a system based on the ACES approach could be built, that could "un-distort" aphasic errors could. This system could potentially be used in real-time (e.g. IM or face-to-face) or in asynchronous communication (e.g. email). While we would likely never achieve 100% accuracy, we strongly believe that even moderate "un-distortion" (e.g., via general summary) could greatly improve day-to-day interaction for individuals with aphasia. A similar system could be built that provides word selection or context summary tools to conversation partners, helping both individuals to choose their vocabulary and understand the conversation. Likewise, when receiving emails from individuals with aphasia, a system that models errors could highlight potential "issues" and suggest various "correct" words that may improve legibility.

Language Error Learning

A much broader direction of future work could be combining language analysis and distortion techniques with data mining and pattern analysis. If a system could detect patterns in a specific individual's speech (who have language impairments) the system itself may be able to provide helpful information about that person's impairment. Ideally this future system could perform diagnosis off of just a limited transcript of dialogue (leveraging active learning), thus creating an accurate "impairment profile." These profiles could be used to help design therapy regiments, or even better classify and cluster those individuals with various types of disorders.

[2]Analysis to-date has only been conducted on syntax, not semantics.

[3]Experiments with ACES are cheaper and less complex than running studies with individuals with aphasia. Therefore, ACES can provide a first pass before a more expensive and cumbersome study is run with individuals that have a disorder.

Non-Disorder Emulations

Clearly, ACES could be generalized to other types of language disorders. However, we believe that there is great potential for improving classroom education and cross-cultural business interactions by emulating the effects of **E**nglish as a **S**econd **L**anguage (**ESL**), or cultural differences inherent in language. Many students and professionals are challenged and frustrated when teachers, faculty and collaborators do not speak fluent English. We hypothesize that some of these challenges may derive from lack of empathy and understanding for the challenges of communicating in a foreign tongue. Given the rich collection of ESL research and data from years of implementation in grade school and higher education programs, we believe an ACES-like system could be created to improve cross-cultural business interactions and classroom education. The broad applicability of this research allows for multiple ESL emulations (e.g. Mandarin to English, Spanish to English) and a variety of applications (e.g. business, grade-school, higher education).

Conclusion

Our cumulative work on ACES highlights the great potential of language emulation software systems that sit at the intersection of human-computer interaction, psychology, and speech and hearing science. Our technological solutions can greatly impact quality of life, quality of care, and knowledge of language disorders while simultaneously developing new computer technologies that advance our understanding of how people interact with technology (and how to design new solutions for interaction). We believe that the great potential of the language emulation software approach lies beyond the concrete results of our experiments to date. By modeling errors and emulating impairments, we can provide a robust platform for improving empathy and understanding, and broadening our knowledge of communication within and beyond language disorders.

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