IPRO 343 Project Plan
Spring 2009

Improving Communication Quality in Noisy and Distracting Environments

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1.0 Abstract

The goal of this project is to identify and provide speech intelligibility benchmarks in different noisy environments. Being able to comprehend speech can vary depending on location and noise level of its surroundings. With that in mind, the project's purpose for the semester will focus on analyzing and experimenting on those comprehensive speech variations that prevent intelligibility. We will then propose a viable solution for speech intelligibility improvements.

2.0 Background

A number of noisy and distracting environments involve communicating information to users through audio-based menus, prompts, and instructions, either from live speakers or speech synthesis. These situations include order taking in fast food drive-thru, automatic subway and bus-stop identification systems, public address and warning systems, menu navigation in cell-phones, voting machines, ATMs, and fare machines for municipal transportation services.

Intelligibility of speech signals differs depending on the interaction between quality of the speech signal and the context within which it is heard. For example, noisy environments, such as a fast food drive-thru, reduce understandability of a speech signal, particularly when the noise is a few people are talking in the background compared to environmental sources (e.g. "white noise") (Koul & Allen 1993; Payton et al 1994; Hoen et al. 2007; Barker 2007). However, as the number of background speakers increases, speech intelligibility improves (Hoen et al 2007). Thus, broadband "white" noise has less of an effect on intelligibility of speech than noise from just a few speakers. In addition, non-native listeners are especially prone to misunderstanding speech in noisy environments compared to native listeners (Van Wingaarden et al. 2002; Van Engeb & Bradlow 2007), particularly when they are listening to synthetic speech (Jones et al 2007). Noisy environments also make fast speech less intelligible (Venkatagiri 2003; Jones et al 2007), whereas in the absence of environmental noise, both fast and slow speech signals are equally intelligible for natural but not synthetic speech (Nelson 1948, Harwood 1955, Jones et al. 2007).

In fall 2008, the work of IPRO 343 focused on factors that may improve accuracy of taking customer orders in a simulated fast food drive-thru environment. Representatives from a major fast food company met with the IPRO 343 F08 team and reported that their employees often have difficulty understanding orders in the drive-thru environment, a situation the representatives attribute to interference from other employees talking (Poonja, Karim 2008, personal communication). The team investigated whether the apparent negative effect of employee chatter can be masked to improve speech intelligibility of drive-thru orders. The team tested the hypothesis that background talk masked by white noise will improve understanding of speech delivered in a drive-thru environment.

The proposed IPRO will examine speech intelligibility in a variety of noisy environments, which may include: intelligibility of public address announcements on CTA L platforms, quality of speech synthesis in devices intended to comply with ADA requirements of accessibility to

disabled persons, and speech intelligibility in toys and other devices. The goal is to develop an overarching set of recommendations about improving intelligibility of speech in noisy and distracting environments.

3.0 Objectives

The goal of this IPRO is to isolate factors that degrade speech intelligibility and propose a means to improve it. To this end:

I. An IPRO sub team will make recordings of public announcements at various venues in the Chicago area. These venues include CTA L platforms and O'Hare airport.

II. Another sub team will analyze the recordings and provide a basic description of the announcements along acoustic parameters known to relate to intelligibility, e.g. speaking rate, intonation, dialect, gender.

III. The most salient of the parameters will form the basis of an experiment designed to test whether the acoustic parameter affects speech intelligibility, e.g. does limited intonation variation negatively affect speech intelligibility.

4.0 Work Breakdown Structure

The work structure was broken down to three phases. Additionally, a review of the project by the entire group will be conducted during and after the midterm review and the final presentation to further inform the continuing IPRO.

I. PHASE ONE

Task	Description	Deadline
Project Plan/IRB Form	Revise and submit the project plan and the IRB form.	02/06/09
Budget Proposal	Revise and submit the proposed budget	02/06/09
Ethics Training	Complete the web training on research ethics.	02/10/09
Record	A team with recording equipment will record automated announcements and etc.	02/17/09
Analyze	A team will analyze the recording for pitch, etc.	02/24/09
Midterm Presentation	A team will compile the data acquired and present	03/02/09

II. PHASE TWO

Task	Description	Deadline
Devise Experimental Material	A team will take the data and devise experimental materials.	03/27/09
Recruitment	A team will recruit IIT students to be our test	03/27/09

	subjects	
Administer the Experiment	A team will administer the experiment and have compiled the results	04/20/09

III. PHASE THREE

Task	Description	Deadline
Exhibit	Design and print the poster	04/29/09
Abstract or Brochure	Design and print the brochure	04/27/09
Final Presentation	Compile all data and develop a PowerPoint presentation	04/29/09

5.0 Expected Results

We expect our results to provide a description of the extent to which existing public announcements in the Chicago area are intelligible. In addition, we are also testing acoustic factors to determine which might lead to more intelligible speech. Our potential sponsor for this project is the Chicago Transit Authority, where the results can help increase the intelligibility of the public address and announcements on the CTA L platforms.

6.0 Project Budget

The proposed budget for Spring 2009 semester is based on the actual expenses in the Fall 2008 semester.

	Fall 2008 Actual Expenses				Spring 2009 Projected Budget		
Experimental Expenses	**Days**	**Price per Day**	**Total**		**Days**	**Price per Day**	**Total**
Participant Incentive/Support - Sodexo Catering	4	$125.00	$500.00		4	$125.00	$500.00
IPRO Day Expenses	**Amount**	**Price per Unit**	**Total**		**Amount**	**Price per Unit**	**Total**
Team Polo Shirts	12	$24.25	$291.00		8	$24.25	$194.00
Exhibit Materials	-	$80.46	$80.46		-	$90.00	$90.00
Other Expenses	**Amount**	**Price per Unit**	**Total**		**Amount**	**Price per Unit**	**Total**
Equipment-Headphones	12	$15.83	$189.96		-	-	-
Travel Expenses	-	-	-		-	$20.00	$20.00
TOTAL EXPENSES			$1,061.42				$804.00

7.0 Team Structure and Assignments

In order to accomplish the objectives of the project for the current semester, the team has been divided according to the tasks that were listed in each phase of the project.

The assigned team roles:

IPRO 343 Team Leader: Shavanna Pinder
IPRO 343 Co-Team Leader: Kevin Arnold

Minute Taker: Justo Moraga
Agenda Maker: Shavanna Pinder
Time Keeper: Kevin Arnold
Weekly time sheets: As a team, we have decided to use the timesheet option in iGroups to record hours spent on IPRO outside of class.
Master Schedule: Since team members are already designated to a given team, there will be no shifting teams unless more help is needed.
iGroups: Every team member will collectively keep iGroups organized on an as needed basis.

The groups are as follows:

PHASE ONE

Groups	Description	Members	Sub-Tasks
Project Plan/IRB	This group handles the submission of the project plan, budget and the Institutional Review Board form (IRB).	Noravidhya Tanapura (Leader)	Organize
		Hyemin Choi	IRB form
		Justo Moraga	Proof read
Recording:	This group will go out and record various speech syntheses for the analytical group.	Kevin Arnold (Leader)	Record
		Brian Bjerke	Record
		Scott Justus	Compile Data
		Shavanna Pinder	Extra Record
Analyzing	Using the program PRAAT, this group will analyze the recordings for pitch, voice onset time, etc.	Jessie Bauer (Leader)	Analyze using PRAAT
		Karen Hong	Analyze using PRAAT
		Justo Moraga	Compile Data

		Noravidhya Tanapura	Analyze using PRAAT
Midterm Presentation	This group compiles the data into PowerPoint and presents for the midterm.	Crystal Reynolds (Leader)	Present
		Scott Justus	Present
		Jessie Bauer	Make Power Point slides

PHASE TWO

Groups	Description	Members	Sub-Tasks
Experiment-Recruiting	Members of this group are in charge of recruiting IIT students to come to the established experiment dates.	Karen Hong (Leader)	Recruit
		Shavanna Pinder	Recruit
		Jessie Bauer	Follow up on the candidates.
		Brian Bjerke	Recruit
		Justo Moraga	Schedule the candidates
Experiment-Devise Material	This group will generate the experimental methods and devices used to test the participants.	Justo Moraga (Leader)	Acquire data from recruit group
		Hyemin Choi	Make experiment materials
		Kevin Arnold	Make experiment materials
		Scott Justus	Make experiment materials
		Noravidhya Tanapura	Compile the experiment material
Experiment-Administering	This group will oversee the experiments on the experiment days and collect the data acquired.	Brian Bjerke (Leader)	Oversee experiment
		Kevin Arnold	Oversee experiment

		Choi	experiment
		Shavanna Piner	Participant incentives
		Crystal Reynolds	Participant incentives

PHASE THREE

Groups	Description	Members	Sub-Tasks
IPRO DAY-Exhibit	Members of this group will design the posters, brochure, and the exhibition table.	Hyemin Choi (Leader)	Design poster
		Karen Hong	Set up exhibit table
		Kevin Arnold	Design brochure
		Noravidhya Tanapura	Design exhibit table
Final Report	This group handles the final report that will be submitted.	Shavanna Pinder (Leader)	Organize report
		Karen Hong	Compile results
		Crystal Reynolds	Proof read
IPRO DAY-Presentation	This group will be in charge of creating the power point presentation and presenting on IPRO Day.	Scott Justus (Leader)	Present
		Jessie Bauer	Make power point slides
		Brian Bjerke	Compile data
		Crystal Reynolds	Proof read

8.0 Team Member's Background and Expectations

I. Team Member's Background

NAME	MAJOR	YEAR	TEAM	SKILLS	INTERESTS
Kevin Arnold	Political Science, Minor in Technical Communications	4th	Co-Team Leader, Recording, Experiment Administering, Experiment Devise Materials, IPRO Day Exhibit	MS Office, Praat, Sound Editing	Foreign languages, National Politics
Jessie Bauer	Computer Engineering	3rd	Experiment Recruiting, Analyze, Midterm Presentation, IPRO Day Presentation	Java, MS Office, Visual Basic	Music, Games, Swing Dancing
Brian Bjerke	Computer Engineering	3rd	Recording, Experiment Recruiting, Experiment Administering, IPRO Day Presentation	MS Office, Adobe Photoshop & Illustrator, InDesign, iMovie, Sound Editing	Technology, traveling, music, exploring
Hyemin Choi	Architecture	2nd	IRB/Project Plan, Experiment Devise Materials, Experiment Administering, IPRO Day Exhibit	Adobe Photoshop & Illustrator, AutoCAD, MS Office, Solidworks	Photography, Movie & Books, Swimming, Running, Playing Tennis, Shopping

Karen Hong	Architecture	5th	Analyze, Experiment Recruiting, IPRO Day Exhibit, IPRO Day Report	AutoCAD, 3D Max, Photoshop, Illustrator, MS Office	Traveling, Books, & trying new things
Scott Justus	Biochemistry	4th	Recording, Midterm Presentation, Experiment Devise Materials, IPRO Day Presentation		Movies, Volleyball, Juggling
Justo Moraga	Computer Engineering	3rd	Minute Taker, IRB/Project Plan, Analyze, Experiment Recruiting, Experiment Devise Materials	C, Java, Adobe Photoshop, MS Office, Sound Forge 7.0 & Acid 4.0	Music, Dancing, Jiu Jitsu, Computers & technology, exploring Chicago, cooking
Shavanna Pinder	Architecture	5th	Co-Team Leader, Recording, Experiment Recruiting, Experiment Devise Materials, IPRO Day Report	3D Studio Max, AutoCAD, Model Making, Hand Drafting, Freehand, Adobe Photoshop & Illustrator, Typing 50 wpm, Basic Spanish	Reading, Photography, Bike-Riding, Traveling, Music
Crystal Reynolds	Psychology, Minor in Biology	4th	Recording (substitute), Midterm Presentation, Experiment Administering, IPRO Day Report, IPRO Day Presentation	Some editing, MS Office, Researching available literature, some Spanish	Health Sciences

Noravidhya Tanapura	Aerospace Engineering	4th	IRB/Project Plan, Analyze, Experiment Devise Material, IPRO Day Exhibit	MS Office, iWork, AutoCAD, Matlab, Maple, Photoshop, Final Cut, Finite Element Analysis, Praat	Snowboarding, Kendo, RC Flying

II. Team Member's Expectations

NAME	SHORT TERM GOAL(S)	LONG TERM GOAL(S)
Kevin Arnold	Within my subteams, I hope that we will be able to provide valuable recordings that can give real, useful material for the other subteams to analyze. Through our experiment, I hope that we will gain further insight into what makes speech understandable, and through our IPRO day team I hope to positively represent the work we have done, and the impact it can make on communications.	My goal for the IPRO is to work towards obtaining information that is both relevant and helpful for the area of communication. Through the process I hope to personally gain skills in linguistics research, speech analysis, and a stronger background in research related to speech intelligibility.
Jessie Bauer	subteam (analysis): To make a detailed analysis of public recordings to identify key factors of speech degration. (midterm presentation): To compile the results of our pre-experiment analysis into a presentation. (Recruitment): To find willing participants for our experiments. (Final Presentation): To combine the summation of our researched and experimental results as a final presentation.	To have a successful project that continues next semester.
Justo Moraga	Within my IRB/Project Plan and material devising group, I plan to expand on my organizational and planning skills. As with my Analyze group, my goal is to learn PRAAT and further expand my knowledge in sound editing. Lastly, I plan to develop my social skills with	By the end of this project, I plan to learn and understand the factors that degrade speech intelligibility. Also, I plan to expand my experiences/knowledge by working with other people as a team.

	working with other people in my team and with the people I meet during the recruiting process.	
Shavanna Pinder	Final IPRO report: be completed in a timely manner and accurately reflect the hard work and dedication of the IPRO members.	In the very end, each member of the team can say they learned something new. We worked together effectively as a team, conducted a successful experiment, and that we enjoyed the experience.
Karen Hong	As recruitment team leader I'd like to be able to recruit as many people as possible in order to have our experiment go smoothly.	To design and execute a successful experiment
Scott Justus	Obtain a variety of recordings for analysis with Praat; Prepare clear and concise presentations	To win IPRO day; Provide a foundation for future projects to launch from.
Hyemin Choi	(IRB/Project Plan) Since we are planning to review IRB by middle of Feb, it is crucial to organize all the needed materials and hand in IRB plan with perfection to prevent any delay. (Experiment) It will be a good opportunity for me to see how pre-researched and analysis are different in reality. (IPRO day exhibition) I would like to develop my visual communication skills.	My goal for this IPRO is learning how to communicate in various situations and meeting new people who are not in major. Through this IPRO, I would like to learn communication skills and time management skills in team oriented project.
Brian Bjerke	Maintain a professional attitude and good cooperative abilities within my sub teams and everyone in our group as a whole. With this in mind, I will get the best recordings, most student participation, a unique and fun experience for those being experimented on, and an outstanding IPRO presentation when my effort is needed.	I envision that our IPRO will essentially solve the problem with misunderstood recordings announced at any public location, if not at the end of this semester, but at least be significantly closer to it so that future semesters of this project will not have much further work to implement.
Crystal Reynolds	As a midterm presentation leader, I'd like to incorporate the experience and lessons learnt from my last IPRO in to this IPRO.	To establish a good foundation for the continuing IPRO group.
Noravidhya Tanapura	In my sub teams that I am a part of, I'd like to provide insight to some of	My goal for this IPRO is to be able to obtain sufficient results from the

	the things I had learned from the previous IPRO. Also, I have taken a class on phonetics in the previous semester and would like to see how I could apply that knowledge to this IPRO.	experiment to be able to market our findings to different organizations.