Designing Tools to Facilitate Students Learning American Sign Language

R·I·T Matt Huenerfauth[1], Elaine Gale[2], Brian Penly[1], Mackenzie Willard[1], Dhananjai Hariharan[1]
[1]Golisano College of Computing and Information Sciences, RIT   [2]CUNY Hunter College

Big Picture: Overall Project

Students learning American Sign Language (ASL) lack interactive tools to give them feedback on their signing accuracy, when a human ASL instructor is not available.

In this multi-university NSF-funded project, we are creating software, utilizing a Kinect camera, to aid students who are learning ASL. In the final system, computer vision software will identify aspects of signing that contain non-fluent movements and give feedback to students practicing ASL independently.

This tool won't replace feedback from ASL instructors; it would only catch certain errors.

Focus of This Study

The focus of this current study is:

How should our system indicate feedback to the student about the errors that were found in their ASL performance?

Since the system isn't built yet, we used a "Wizard of Oz" approach to create prototypes of different ways of providing feedback, and we compared each of the alternatives.

Methods

We designed video-based prototypes for displaying feedback to ASL students.

Students performed ASL homework assignments recorded as video submissions. The videos were linguistically annotated to identify errors, and feedback videos were produced to indicate errors to students.

The students viewed the feedback videos, and they re-attempted the homework again. An ASL instructor graded both attempts.

Results

Students preferred tools that gave feedback; such videos led to the greatest reduction in student production errors. In addition, students preferred videos in which feedback was time-aligned with their signing.
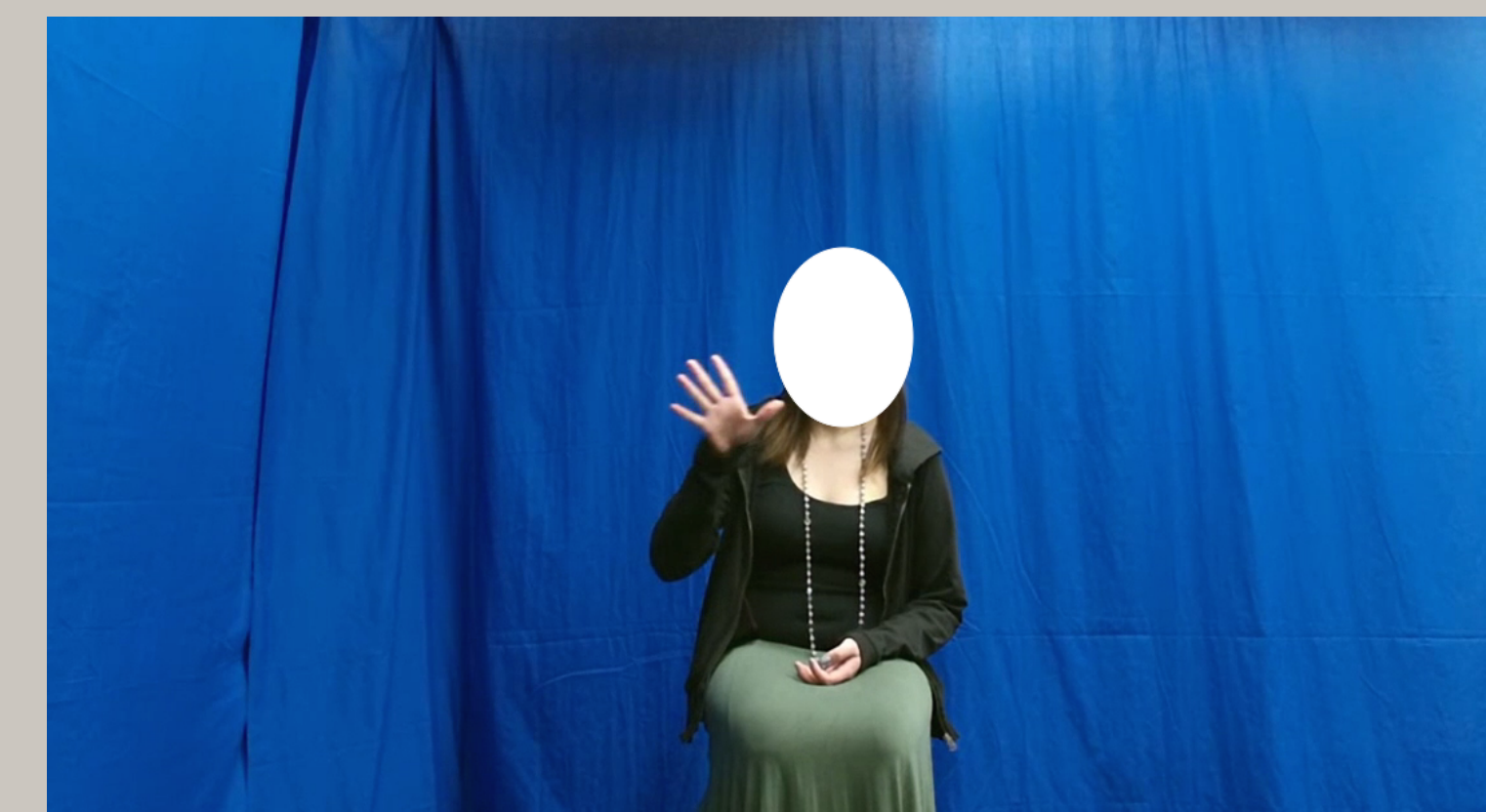
Discussion

The results guide how our tool should be designed for this project, and it also suggests ways for ASL instructors to best provide feedback to students. Our collection of videos of ASL students and fluent signers, with annotation of linguistic phenomena and errors, will also support research on ASL.
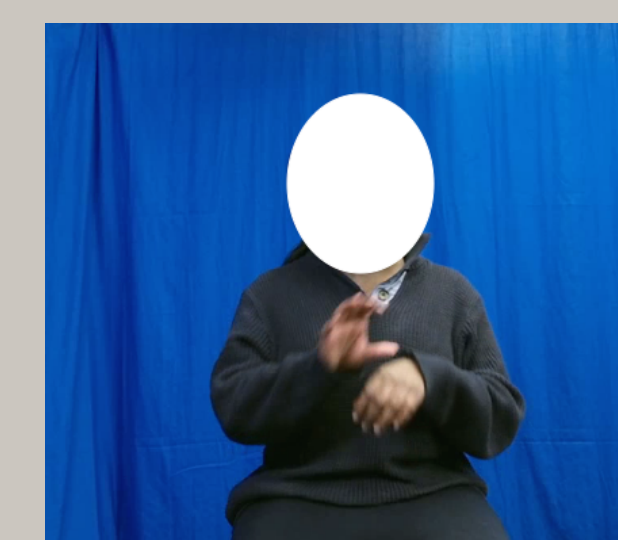
Feedback Conditions

VIDEO:
Replay the student's first video without any feedback provided

FEEDBACK:
Provide feedback to the student

a. *NOTES:* Text at end of the student's video with feedback

NOTE (1/2):
You performed a negative word, but there was no NEGATIVE facial expression.

b. *POPUP:* Feedback messages appear during the student's video when errors occur

You performed a negative word, but there was no NEGATIVE facial expression.

Errors Identified in Videos

In this study, 17 unique error codes and 7 unique correct-usage codes were used to annotate the participants' ASL recordings. This table includes examples of error codes and correct-usage codes used for analyzing students' recordings.
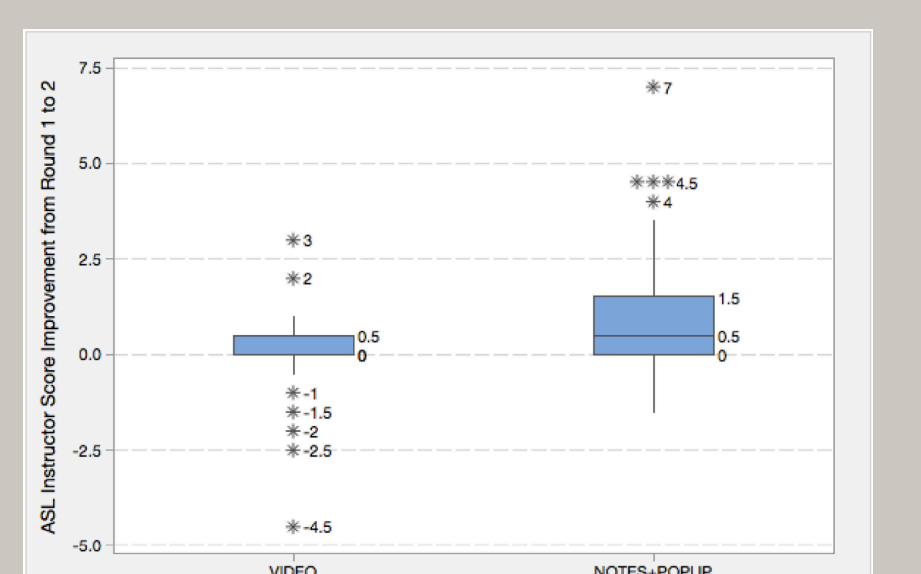
Code	Description	Onscreen message displayed to student in FEEDBACK conditions (NOTES and POPUP)	Where the arrow should aim for POPUP stimuli
Error_topic_beginning	Did a Topic facial expression begin too far from a clause boundary?	TOPIC facial expressions must start at the beginning of the clause.	Face
Error_point_gaze	Is the signer performing a pointing sign without eye-gaze aimed at that location?	The first time you point to a location in space (to refer to someone or something), your eyes should look at the location.	Face
Error_neg_lexical	Is the signer performing a negative word without a Negation facial expression?	You performed a negative word, but there was no Negative facial expression.	Face
Error_hands_down	Is the signer putting their hands down too frequently during the signing?	You should try to sign in a fluid manner, without putting your hands down too frequently.	Torso
Error_fingerspell_loc	Is fingerspelling happening now with the hand in an inappropriate location?	During fingerspelling, your hand should be near your mouth (without blocking it) and at the height of your chin or shoulders.	Hand
Error_wh_lexical	Is the signer performing a WH question word (e.g., WHO) without performing a question facial expression?	You performed a question word, but there was no Question facial expression.	Face
Correct_contrastive	Is contrastive role shifting (torso swivel) happening now correctly?	You appeared to use good contrastive structure (torso movement) during your signing.	Torso
Correct_topic	Is a Topic facial expression being performed correctly at the beginning of a clause?	You appeared to use a Topic facial expression correctly during your signing.	Face

Response Data Collected

Students answered a scalar question to subjectively rate the quality of the feedback videos they saw. An ASL instructor graded both homework attempts (without knowing which was was the first or second attempt).

Participant	VIDEO	FEEDBACK	
		NOTES	POPUP
"A"	10	10	10
"B"	3	7	9
"C"	6	7	7
"D"	1	5	8
"E"	5	7	9
"F"	3	9	10
"G"	3	5	10
"H"	2	7	10

Subjective evaluation scores for each stimulus condition.

Improvement in grade from ASL instructor.