Fluidity: Real-time feedback for speaking fluency development

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Overview

- Background
  - Automated assessment and feedback
  - Fluency in L2 speech
- Fluidity overview
- Usability evaluation
- Summary

Automated assessment of L2 speech

- Pronunciation (with visual feedback*)
  - Segmental: Cucchiarini et al 2009; Patten and Edmonds 2013*
  - Supra-segmental: Anderson-Hsieh 1992*; Taniguchi and Abberton 1999*; de Wet et al 2009
- Fluency
  - ETS SpeechRater (Zechner et al 2009)
  - Versant (Pearson, Ordinate; Bernstein 1999)
  - CASEC (Hayashi et al 2004)

Useful overviews: Eskenazi 2009; Gamper and Knapp 2010

Feedback to learner

- Eskenazi (1999) - “Learners must receive pertinent corrective feedback”
- Most systems provide rapid feedback.
- In human-human communication, some feedback is in real-time
  - Back-channeling (uh-huh)
  - Head movements (nodding, shaking)
  - Facial expressions
- Is it possible to provide real-time feedback on fluency-related matters in human-computer interaction?

Fluency in L2 speech

- Scope
  - Broad: speak a language proficiently
  - Narrow: speak smoothly with minimal but natural hesitation
- Segalowitz (2010): levels of fluency
  - Cognitive fluency: ease of mental preparation
  - Utterance fluency: smoothness of articulation
  - Perceptual fluency: hearer's view of smoothness

Focus of the present work

Fluency in L2 speech

- Crosslinguistic Corpus of Hesitation Phenomena (Rose 2013: http://filledpause.com/chp/cchp)
  - Speech recordings of Japanese (L1) and English (L2)
  - Parallel elicitation tasks: read/spontaneous speech
  - Intra-speaker comparisons possible
- Fluency factors that correlate with L2 proficiency
  - Speech rate] Correlated with L1 speech
  - Silent pause rate
  - Silent pause duration] Independent of L1 speech
  - Filled pause rate

Fluidity: fundamental aims

- Measure various utterance fluency characteristics and update them in real-time.
- Provide real-time feedback to learner on utterance fluency measures.
- Provide opportunity for learner to review their production together with visual representation of fluency measures.
- Provide feedback in a manner that emulates human-human communication.

Current focus of development

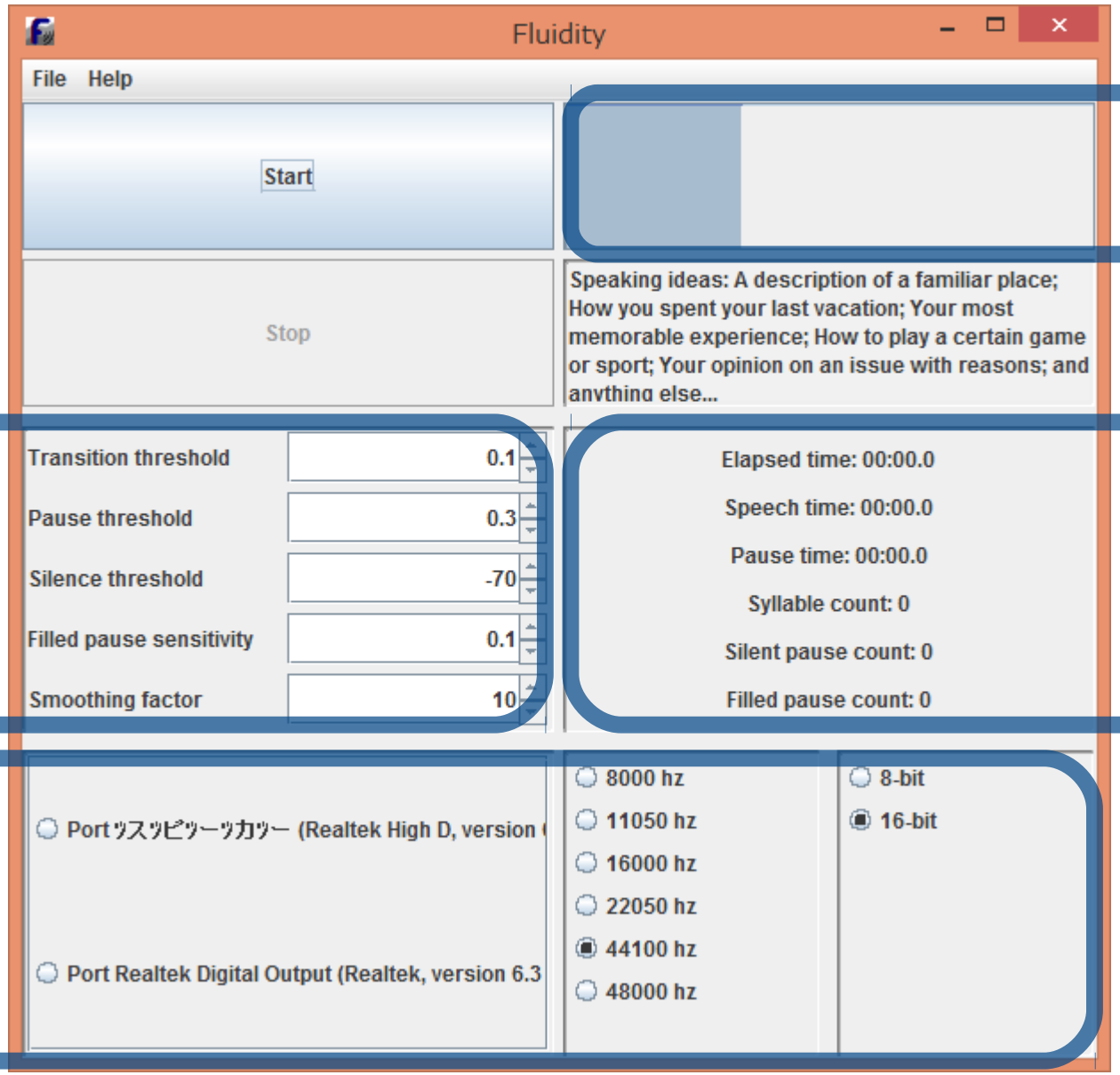
A work in progress!

Fluidity: fluency measures

- Phonation time
- Silence time
- Syllable count: energy peaks
  (cf., Bhat et al 2010)
- Silent pause count: silence > 300ms
  (cf., De Jong and Bosker 2013)
- Filled pause count: stable formants and pitch
  (cf., Audhkhasi et al 2009)

Fluidity: main window

Requires Java SE 6 or greater



audio level meter

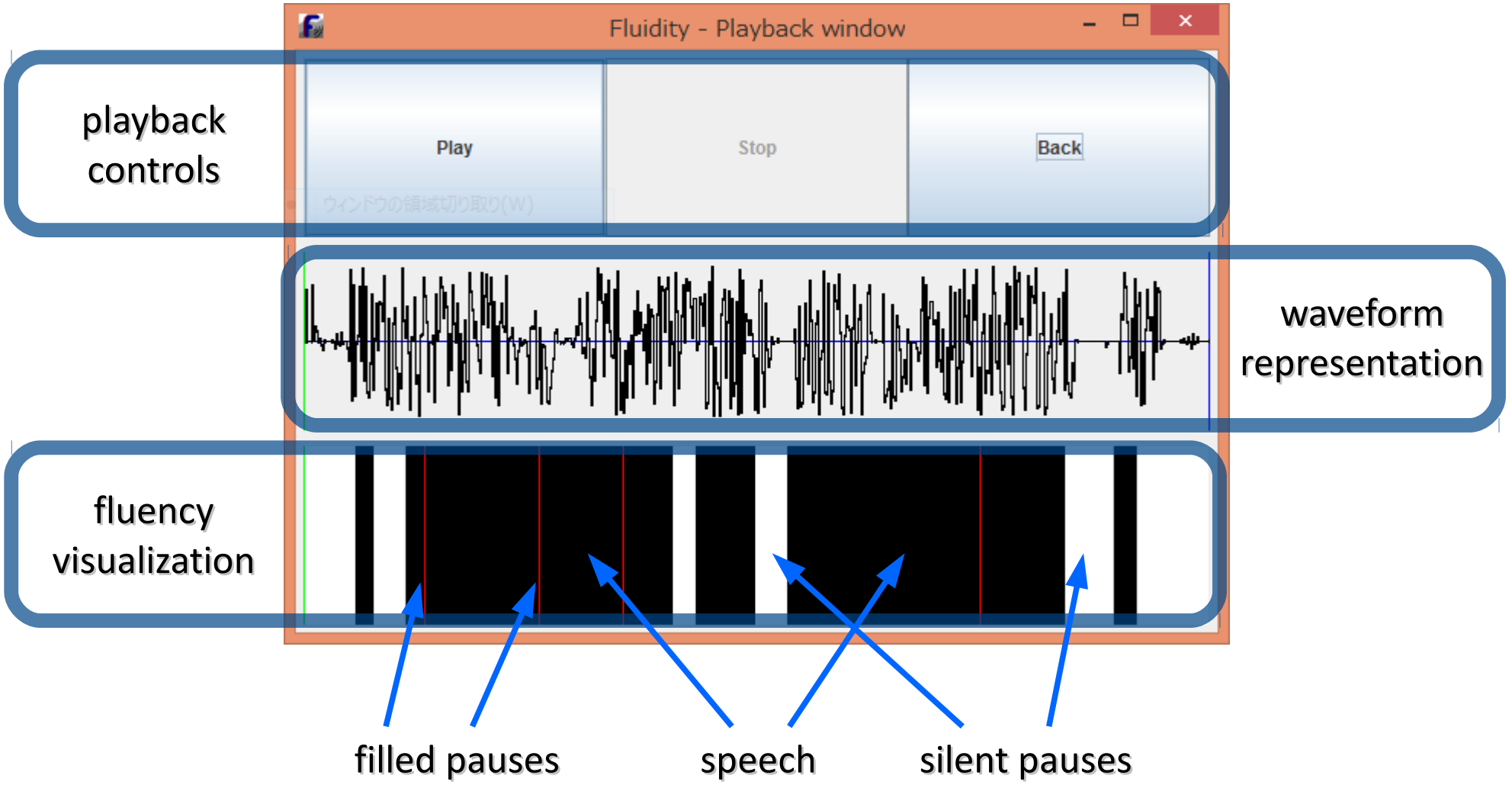
detection settings

fluency measure indicators

audio input settings

Uses TarsosDSP (Joren Six) and AudioInfo.java (Jonathan Simon) libraries

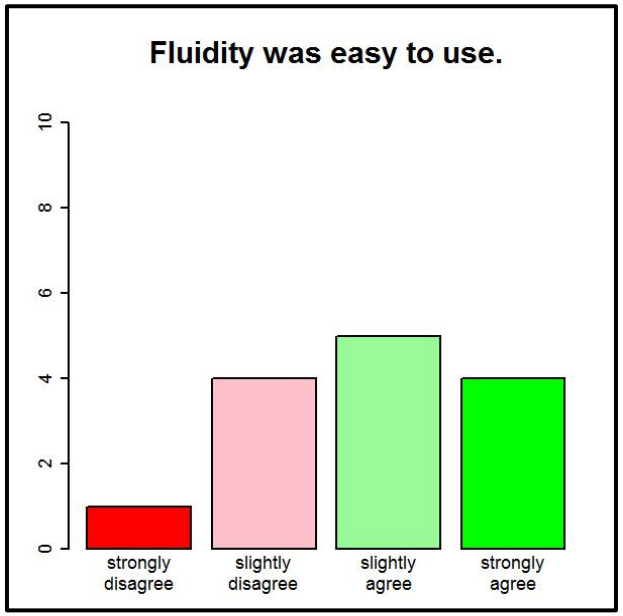
Fluidity: playback window

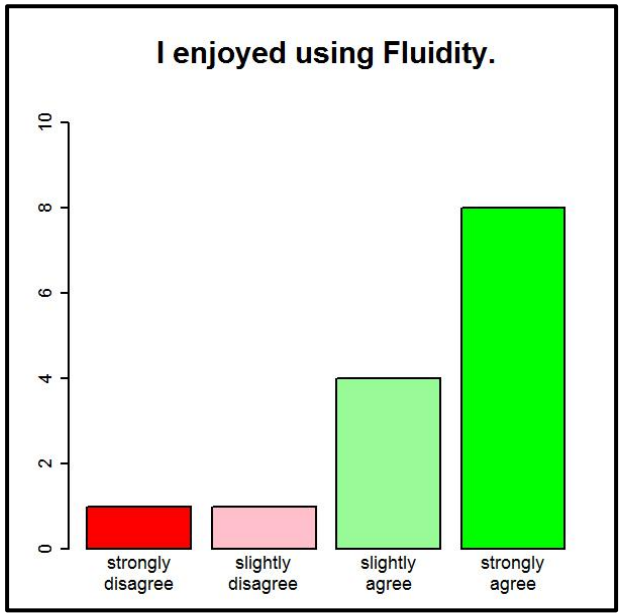


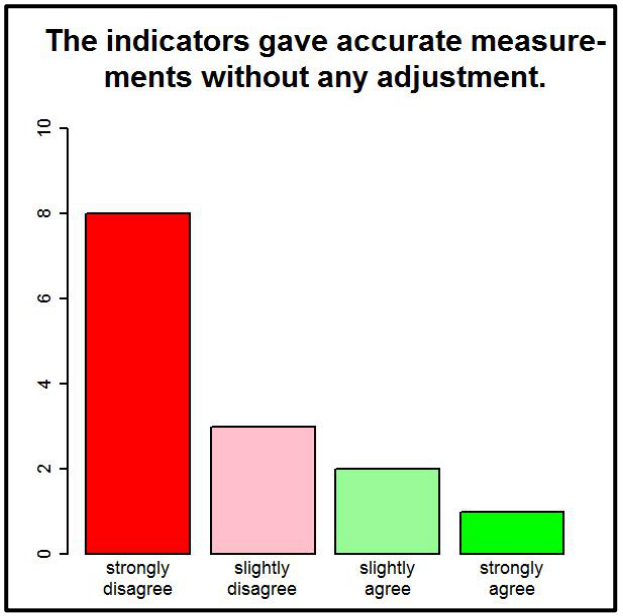
Fluidity: usability testing

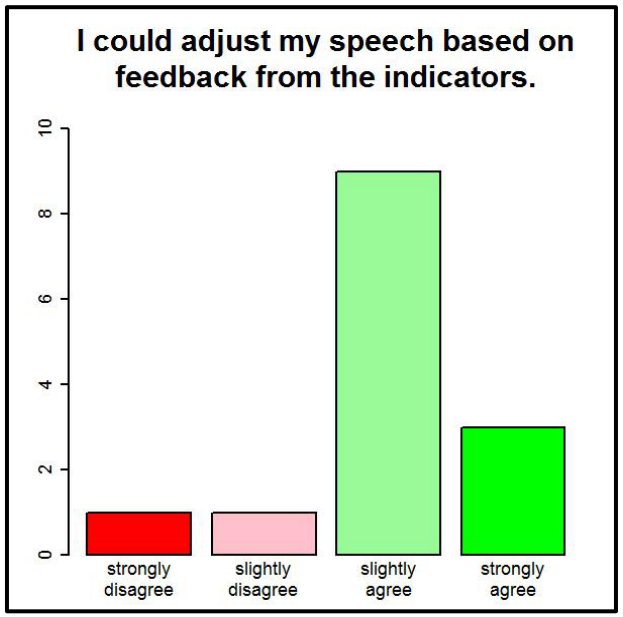
- Participants (n=14, so far)
- Procedure
  - Practice speaking with Fluidity.
  - Adjust settings to fit their production.
  - Respond to survey questions about the experience.
- Still in progress...

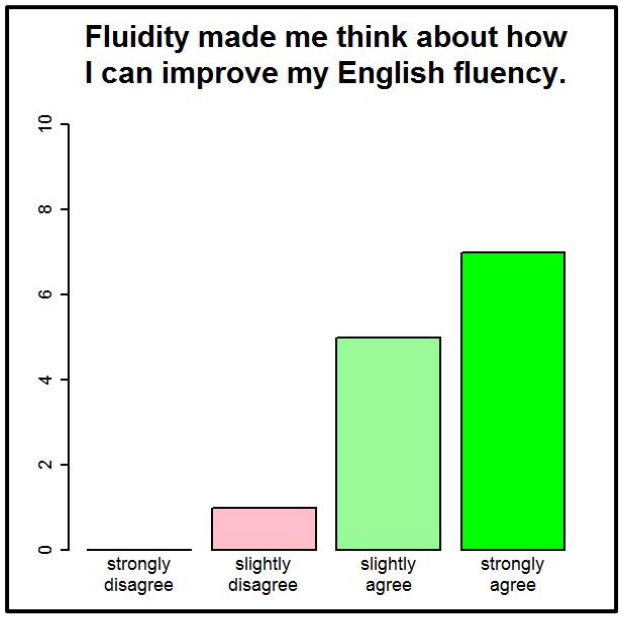
Fluidity: user response

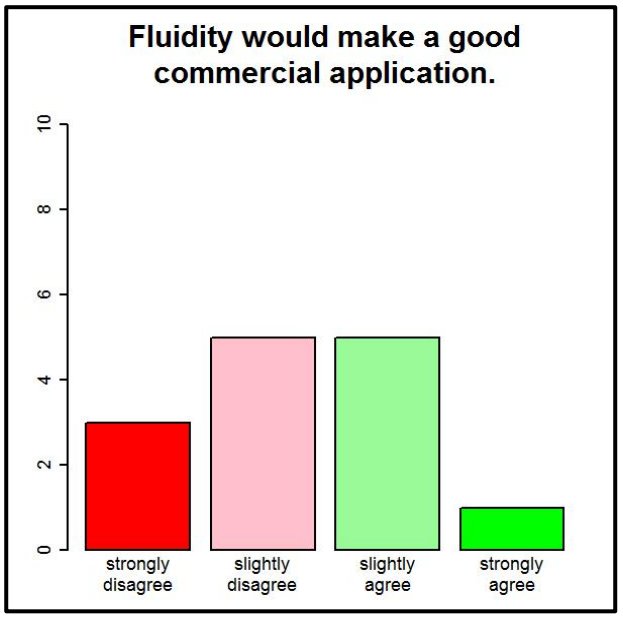




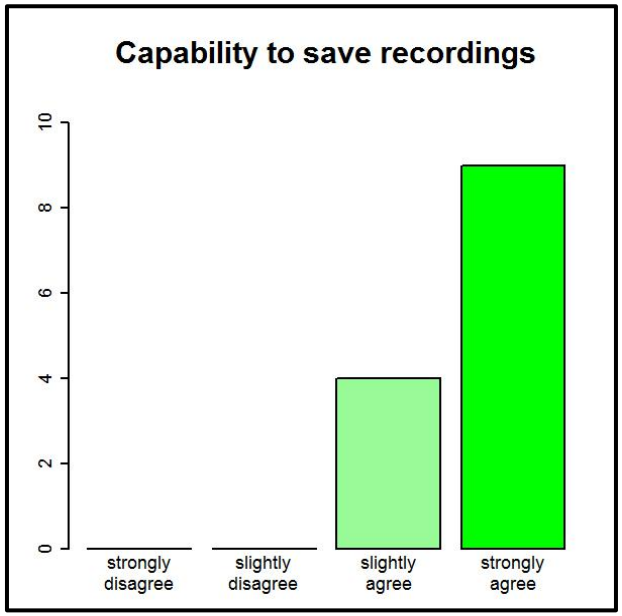


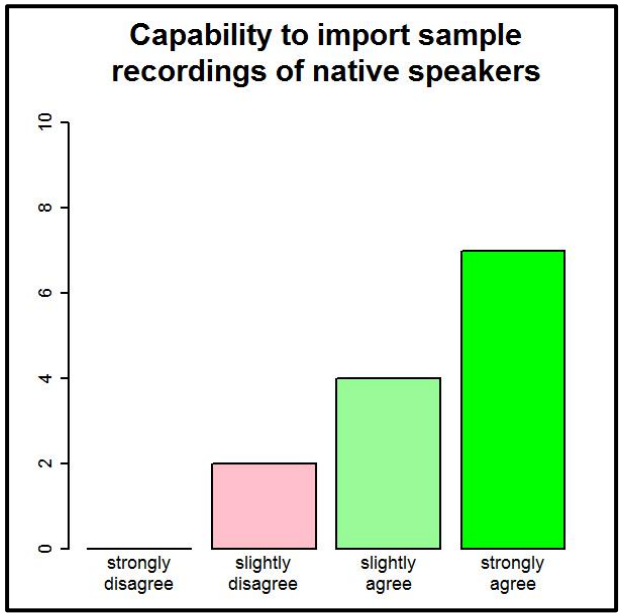


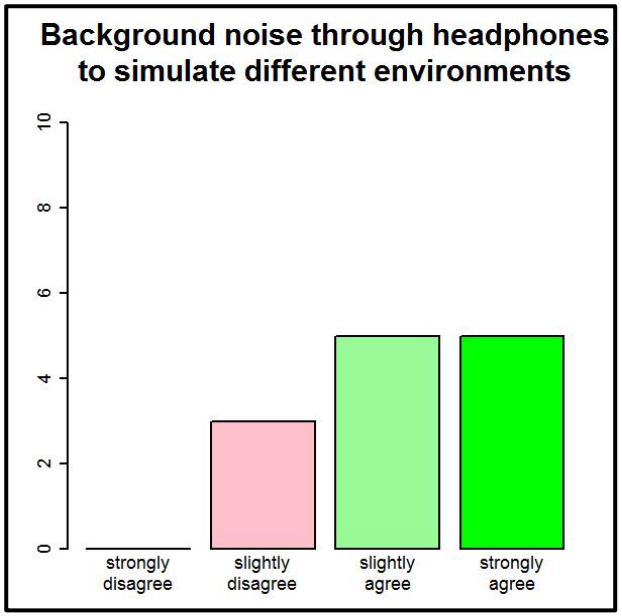


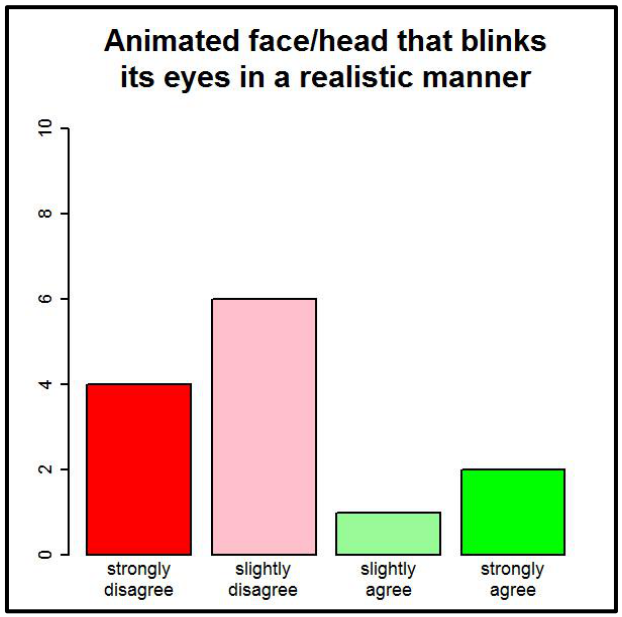


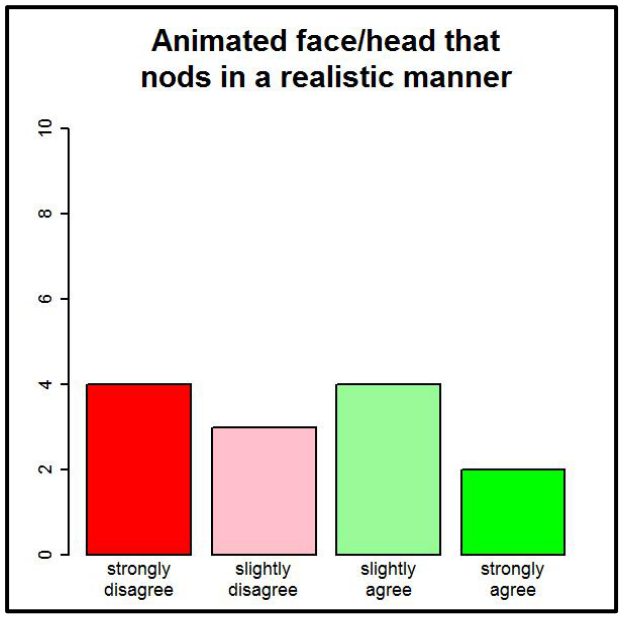
Fluidity: desirable features

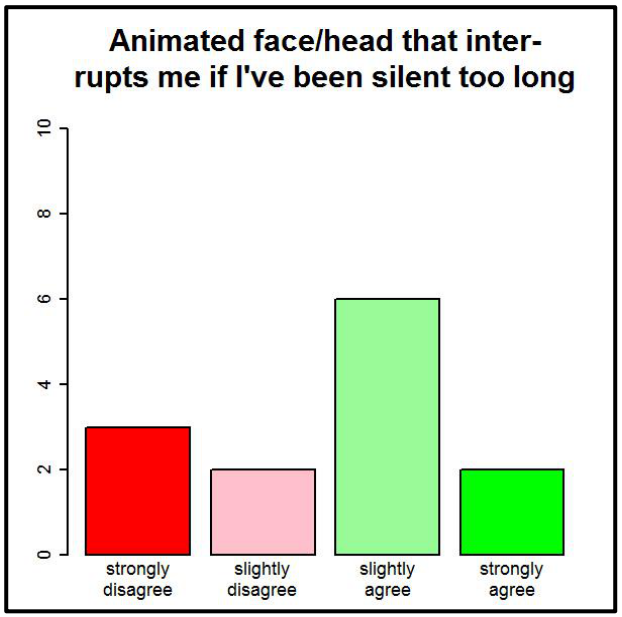












Fluidity: technical considerations

- Silence threshold often needs to be adjusted.
  - Solution: Do a better job of auto-detecting the sound configuration and microphone settings.
- Filled pause detection is difficult. Even after adjusting sensitivity, many participants did not see their filled pauses detected accurately (or at all).
  - Solution: Try other algorithms for detecting stable formants and pitch.

Fluidity: user comments

- 「語学を専攻していましたが，発音や文法にとらわれることが多く，流暢さを考えることがあまりなかったので，勉強になりました。」
  - Although I majored in languages, I have mostly studied about pronunciation and grammar and have not studied much about fluency. So, this was very educational.
- 「具体的にどうすれば良いかは分かりませんが，この「 Fluidity 」を基板としたゲーム形式のアプリを使えれば，すごく楽しく使えるかと思います。」
  - I wasn't really sure how to make use of Fluidity objectively, but if I could use it like a game application, I think it would be very enjoyable to use.

Summary

- Fluidity is designed to give real-time feedback to L2 English speakers on their utterance fluency.
- The application is still under development, but is capable of providing real-time feedback on most fluency measures, plus visualizations for review.
- Users find the application interesting, fun, and they are motivated to think about how to improve fluency.
- Users noted that the interface is difficult to use, and filled pauses are not accurately detected.
- Future development will include improving accuracy of fluency measurements and creating a user interface that better matches human-human interaction.

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