Pausing patterns in the first and second language speech of native Japanese speakers

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Features of fluency: Case of Kei Nishikori

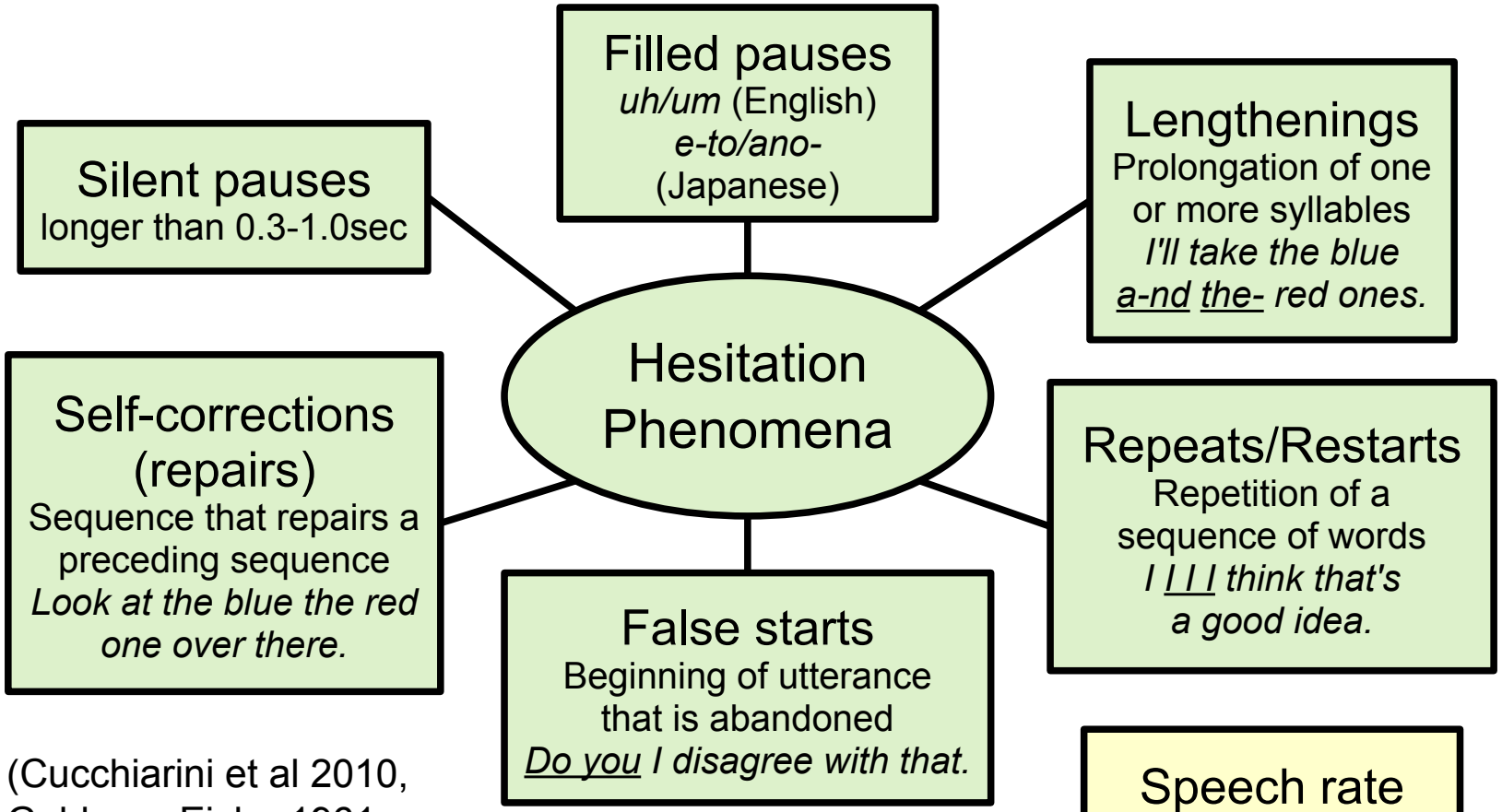
- Japanese speech
  - Filled pauses: “e-”
  - Very few silent pauses
  - Some fixed expressions
- English speech
  - Filled pauses: “uh” / “um”
  - Very few silent pauses
  - Discourse markers: “you know”, “kind of”

https://youtu.be/CQuAZGyEsu0

Fluency

- Scope of fluency
  - Broad: speak a language proficiently
  - Narrow: speak smoothly with minimal but natural hesitation
- Segalowitz (2010) taxonomy of fluency types
  - Cognitive fluency (in speech planning)
  - Utterance fluency (in speech production/articulation)
  - Perceived fluency (from listener's perspective)
- Numerous investigations of second language fluency development (De Jong et al 2012, inter alia)
- Numerous investigations of classroom methods for developing L2 fluency (Nation 1989, De Jong and Perfetti 2011, inter alia)

Temporal variables in utterance fluency



(Cucchiarini et al 2010, Goldman-Eisler 1961, Levelt 1983, 1989, Maclay and Osgood 1959, Rochester 1973, inter alia)

Crosslinguistic Corpus of Hesitation Phenomena

- CCHP (Rose 2013)
- Participants: L2 learners of varying proficiency levels
- Elicitation tasks (both L1 and L2)
  - Spontaneous speech: picture description, topic narrative
  - Reading aloud
- Annotation
  - Transcript with FPs, repairs, etc.
  - Two annotators, one checker
  - Temporal measurements: auto (Quené et al 2011) & manual

```
<UTTERANCE>
 <T>in</T>
 <T>America</T>
 <T FILLED-PAUSE="yes">uh</T>
 <T>there's</T>
 <T>a</T>
 <T FILLED-PAUSE="yes">uh</T>
 <T>very</T>
 <T>famous</T>
 <T FILLED-PAUSE="yes">uh</T>
 <T>and</T>
 <T>loved</T>
 <T FILLED-PAUSE="yes">uh</T>
 <T>basketball</T>
 <RP>
  <O>
   <T>cl#</T>
  </O>
  <T FILLED-PAUSE="yes">uh</T>
  <E>
   <T>association</T>
  </E>
 </RP>
 <T>which</T>
 <T>is</T>
 <T>called</T>
 <T>NBA</T>
 <T>National</T>
 <T>Basketball</T>
 <T>Association</T>
 <T>I</T>
 <T>think</T>
</UTTERANCE>
```

CCHP: Basic statistics

- Participants: 35 Japanese L1 / English L2 speakers

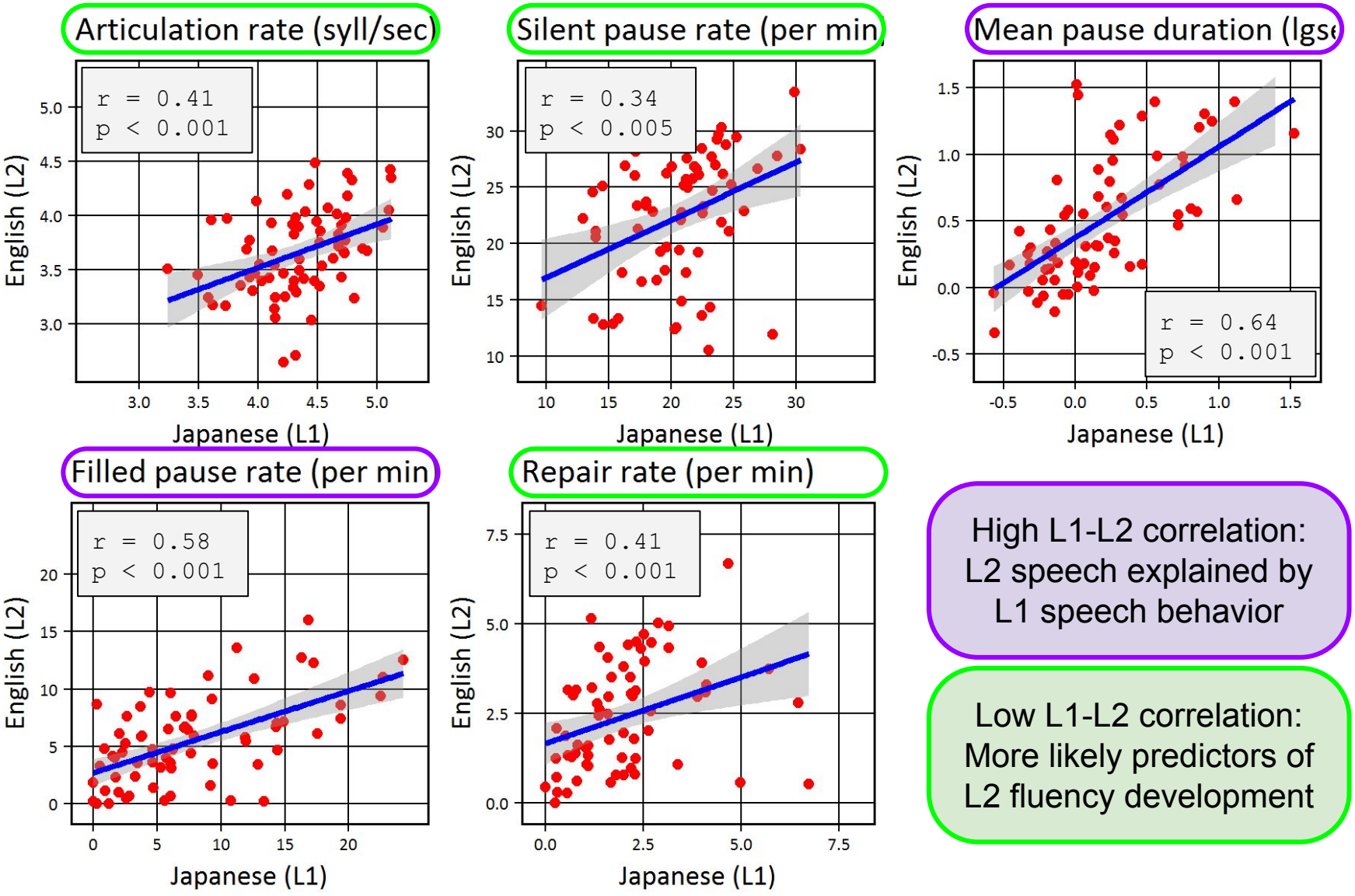
	Word count	Time
Read speech	21,406	2 hr, 41 min
Picture description	19,732	4 hr, 39 min
Topic narrative	21,138	4 hr, 35 min
Total	62,276	11 hr, 56 min

Hesitation phenomena

- 15,480 silent pauses
- 3,741 filled pauses
- 1,635 repairs
- 566 repeats

Transcriber agreement = 91.5%

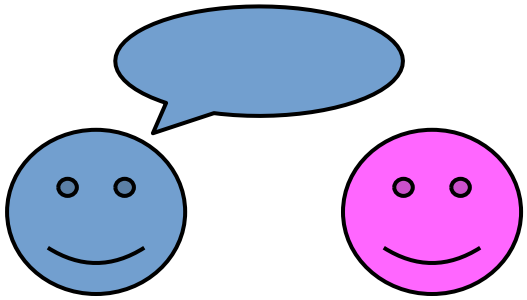
L1-L2 temporal pattern correspondence



High L1-L2 correlation: L2 speech explained by L1 speech behavior

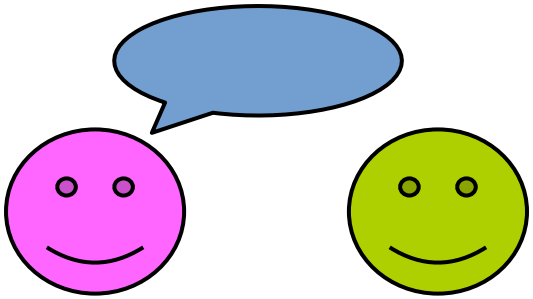
Low L1-L2 correlation: More likely predictors of L2 fluency development

Crosslinguistic communication



native speaker

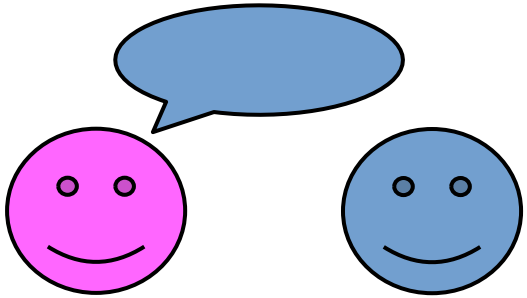
nonnative listener



nonnative speaker

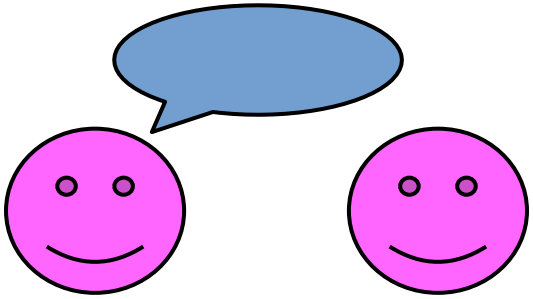
nonnative listener

non-shared native language



nonnative speaker

native listener



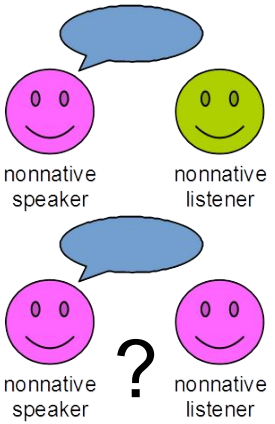
nonnative speaker

nonnative listener

shared native language

Crosslinguistic speech perception

- Perception of nonnative speech modulated by listener's language background
  - Wester and Mayo 2014 – nonnative listeners judge accentedness more harshly than native listeners
  - Bent and Bradlow 2003 – nonnative listeners comprehend better than native listeners
- Crosslinguistic perceptions of fluency, too
  - Rossiter 2009
    - Fluency ratings: nonnative listeners < native listeners
    - Both native/nonnative listeners' ratings correlated with articulation rate and pause frequency
  - Foote and Trofimovich 2016 – native listeners attend to pause frequency; nonnative listeners to speech rate

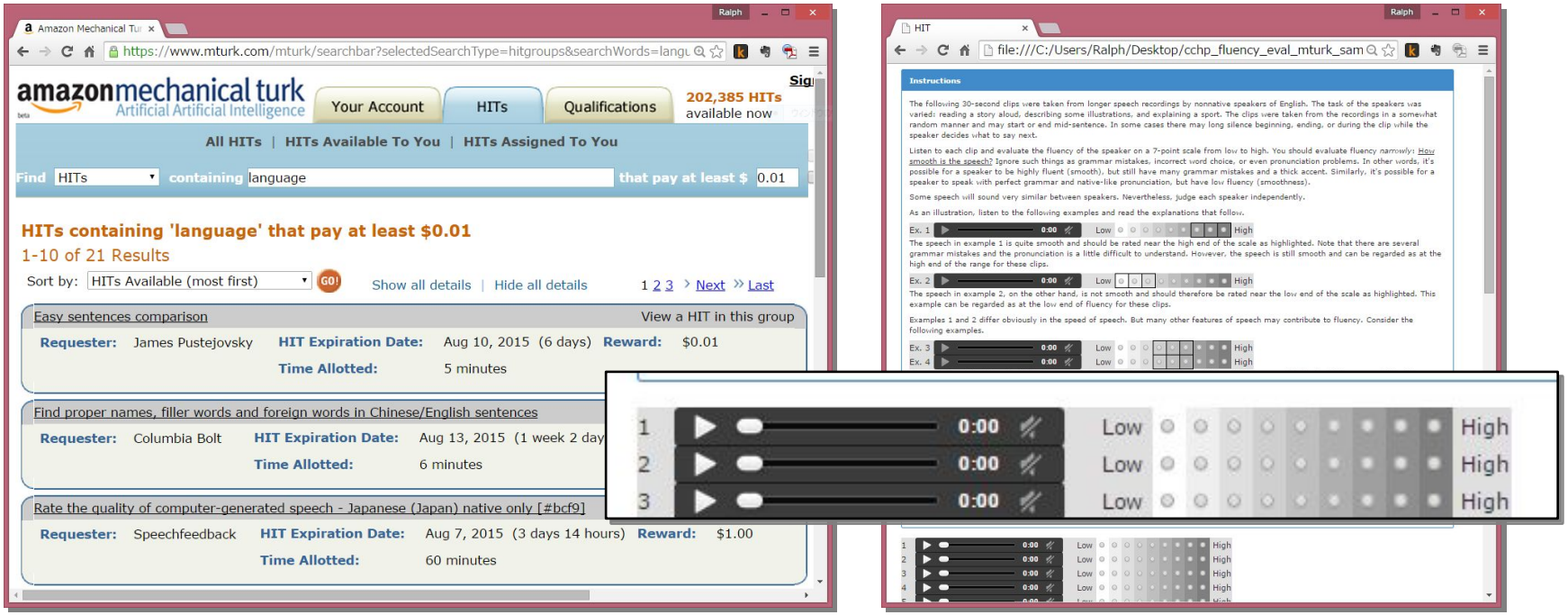


Fluency ratings

- Extracted 7 30-second clips of English speech per speaker
  - Reading aloud x 1
  - Picture description x 3
  - Topic narrative x 3
- Rater instructions
  - Rate fluency on 9-point scale (1 – low … 9 – high)
  - Rate “smoothness” of the speech
  - Ignore pronunciation, grammar, word-choice, etc.

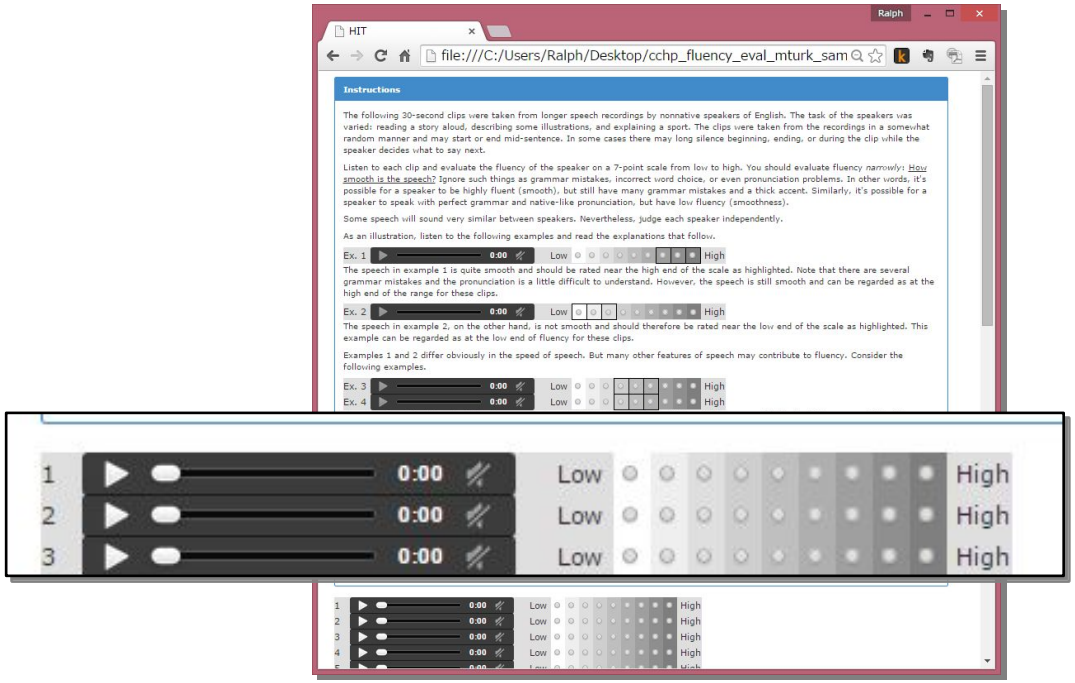
Fluency ratings by native listeners

- Obtained via Amazon Mechanical Turk
- Workers limited to native English speakers (self-reported)
- Used attention checks and monitoring of audio player activity to check that instructions were followed.



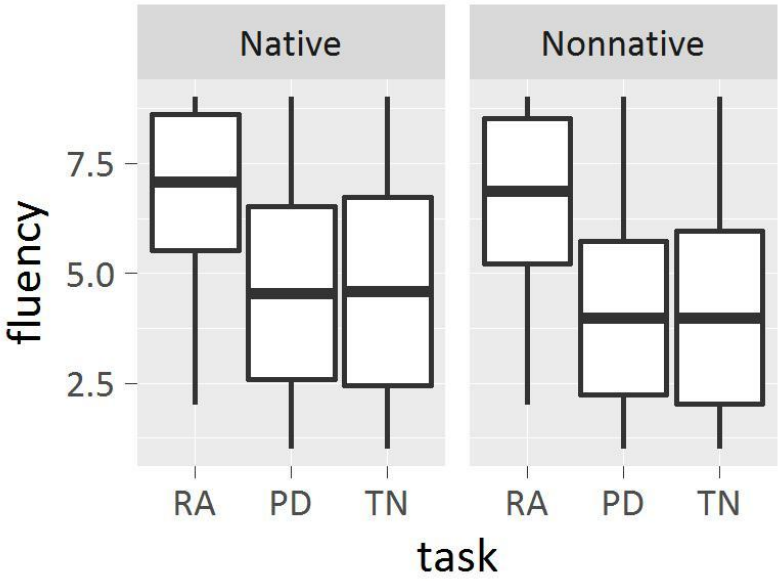
Fluency ratings by nonnative listeners

- Obtained via local web pages in computer lab
- Participants limited to native Japanese speakers (recruited)
- Used attention checks and monitoring of audio player activity to check that instructions were followed.



Fluency rating results

- Participants: 34 native English raters; 20 native Japanese raters
- Nonnative (Japanese) raters judge fluency lower than native (English) raters (similar to previous work)
- Reading aloud judged more fluent than other tasks



Effect	DFn	DFd	F	p	p<.05
raterlang	1	52	7.581507	8.104075e-03	*
task	2	104	485.145647	1.850916e-53	*
raterlang:task	2	104	2.312539	1.040802e-01	

Fluency rating results

- Linear regression modeling (using `lm` in `R`)
  - Dep. var: fluency rating
  - Ind. vars: articulation rate, pause rate, pause length, filled pause rate, repair rate, rater's listener status, speech task
- With full model, all variables significant except task
- But by rater group, relevant temporal features are different

Higher fluency associated with...	native raters	nonnative raters
higher articulation rate	✓	✓
lower pause rate		✓
shorter pause length	✓	✓
higher filled pause rate		✓
lower repair rate	✓	
	[R^2=0.45]	[R^2=0.57]

[F(7,406)=64.9, p<0.001; adjusted R^2=0.52]

Summary, so far

- Pause duration and filled pause rate are highly correlated between first and second language speech.
- Hence, articulation rate, silent pause rate and repair rate are more likely to be predictive of fluency development.
- Articulation rate and pause duration are most reliable predictive factors of perceptual fluency for both native and nonnative listeners.

Conundrum: pause duration!

So, be like Kei Nishikori!

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?

Fluidity: fundamental aims

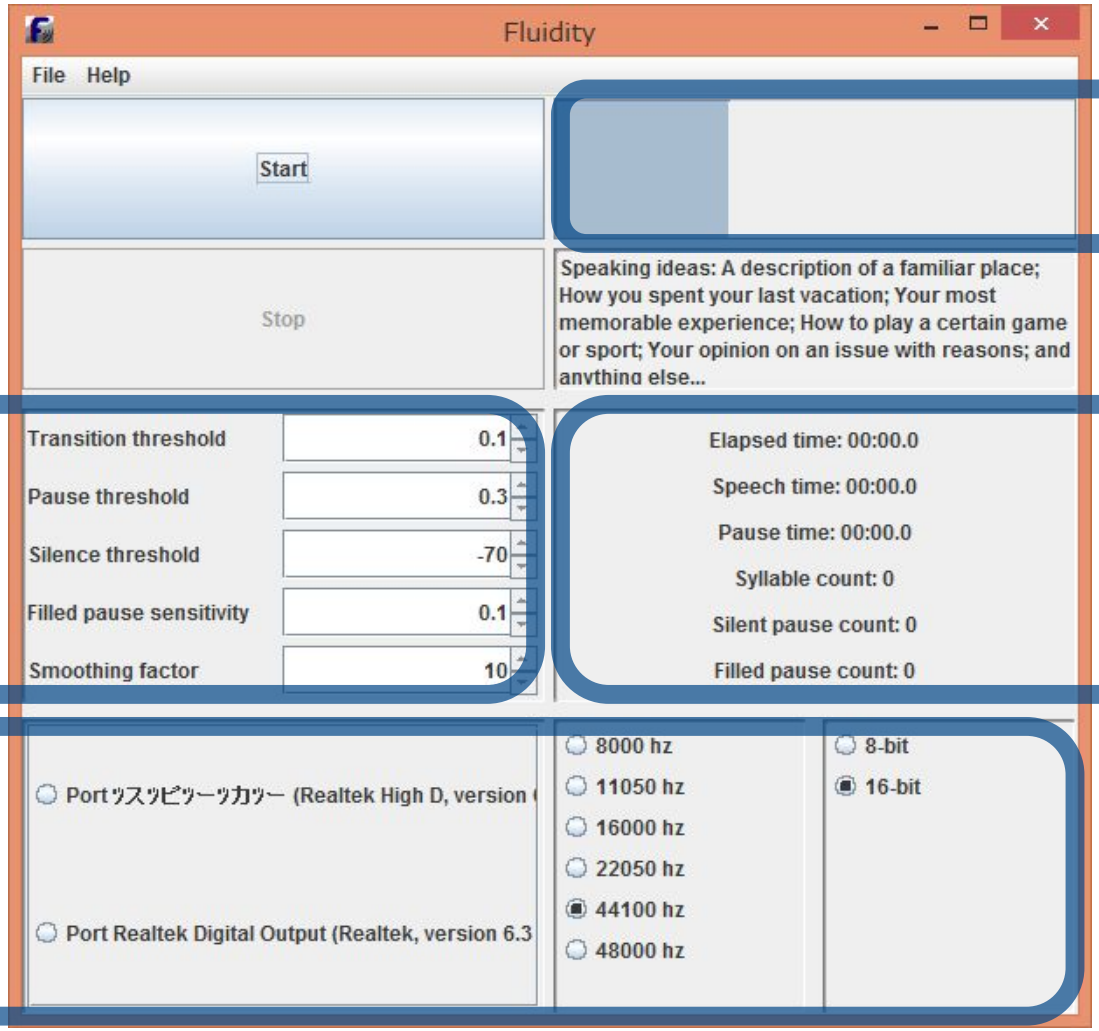
- Measure various utterance fluency characteristics and update them in real-time.
- Provide real-time feedback to learner on utterance fluency measures.
- Provide opportunity for learner to review their production together with visual representation of fluency measures.
- Provide feedback in a manner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

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., Shriberg and Lickley 1993, Tseng 1999, Audhkhasi et al 2009)

Fluidity: main window



Requires Java SE 6 or greater

audio level meter

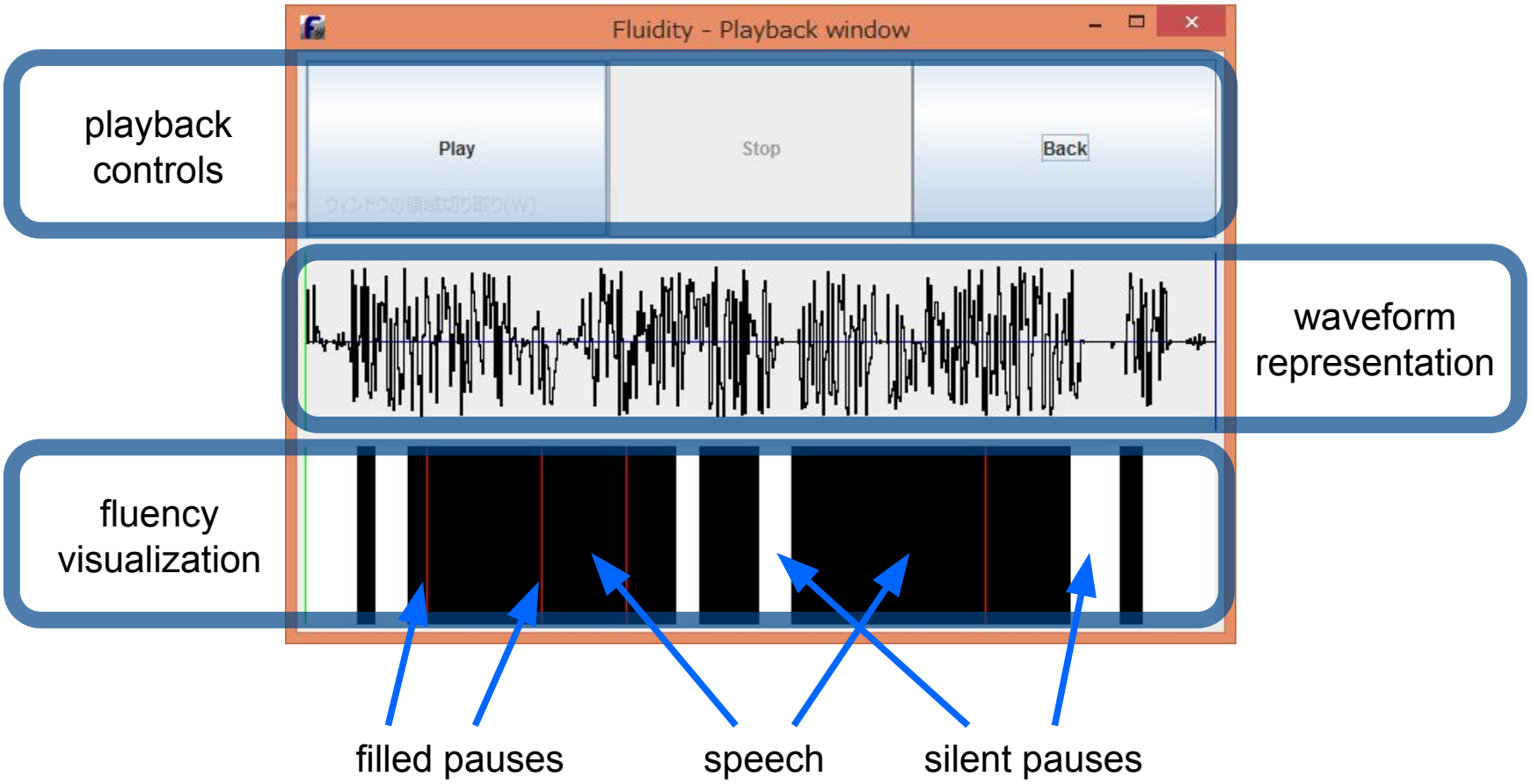
detection settings

fluency measure indicators

audio input settings

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

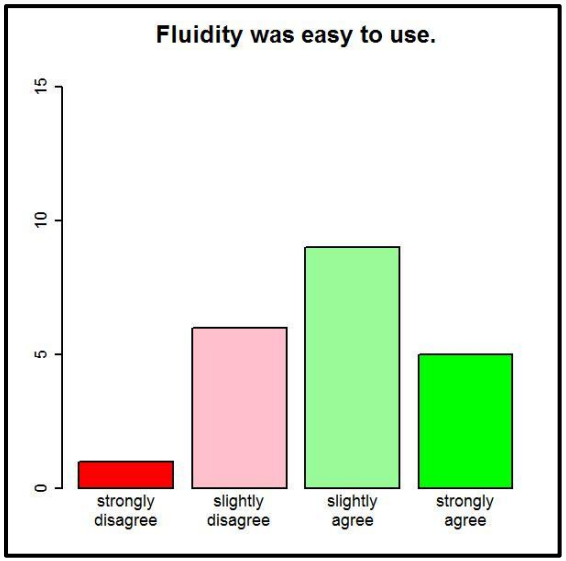
Fluidity: playback window

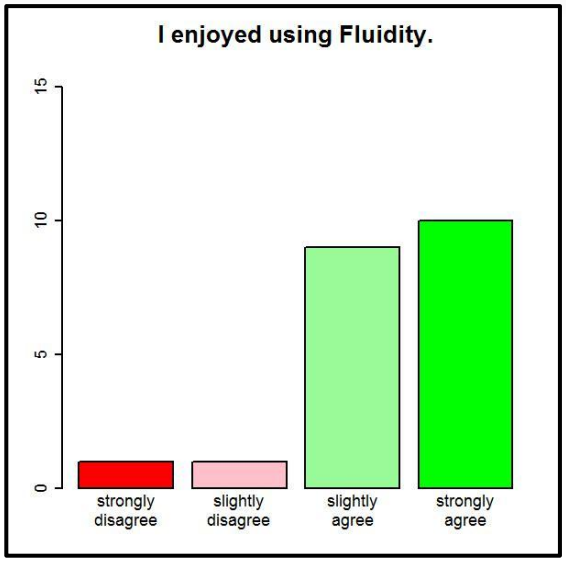


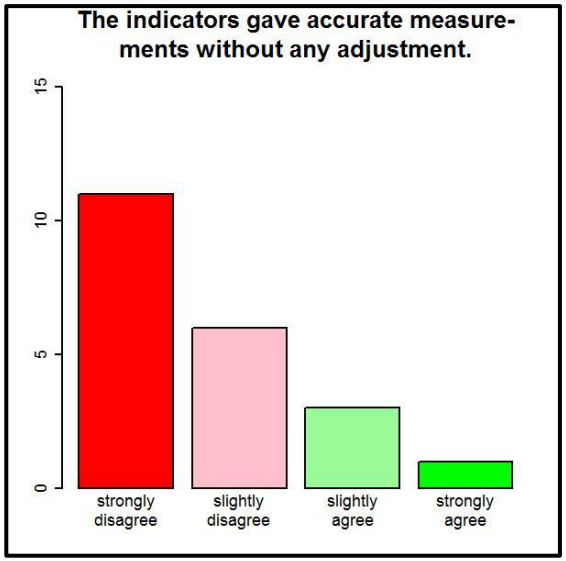
Fluidity: usability testing

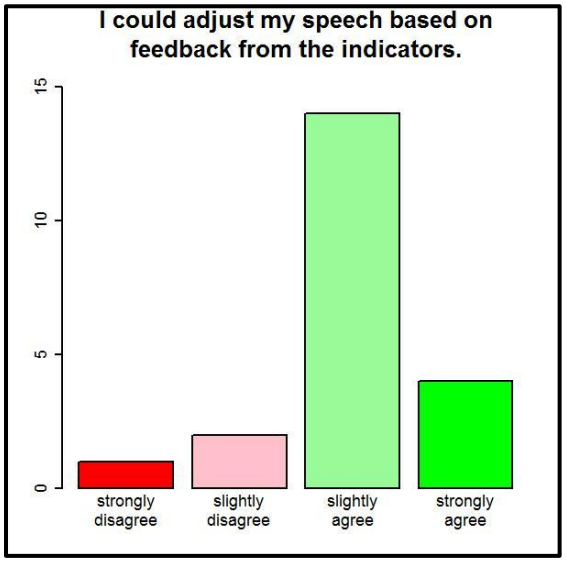
- Participants (n=21)
- Procedure
  - Practice speaking with Fluidity.
  - Adjust settings to fit their production.
  - Respond to survey questions about the experience.

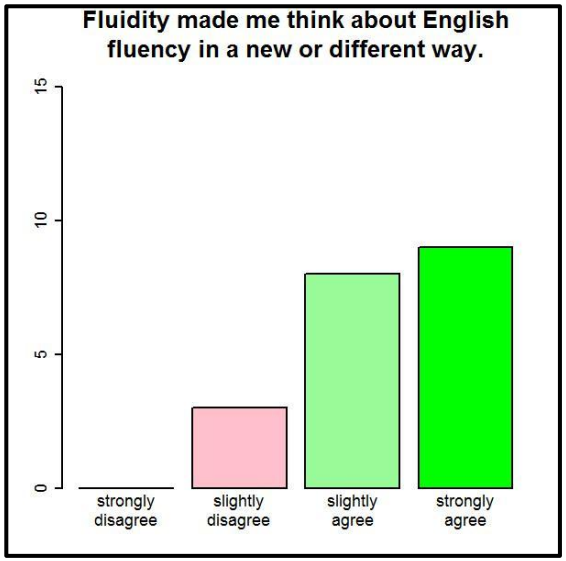
Fluidity: user response

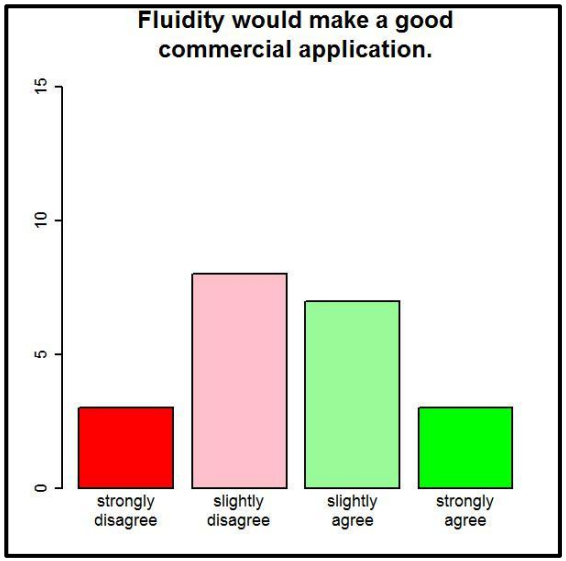




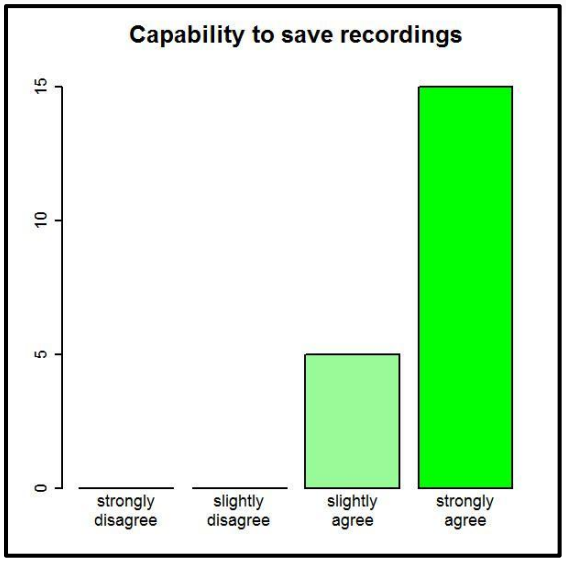


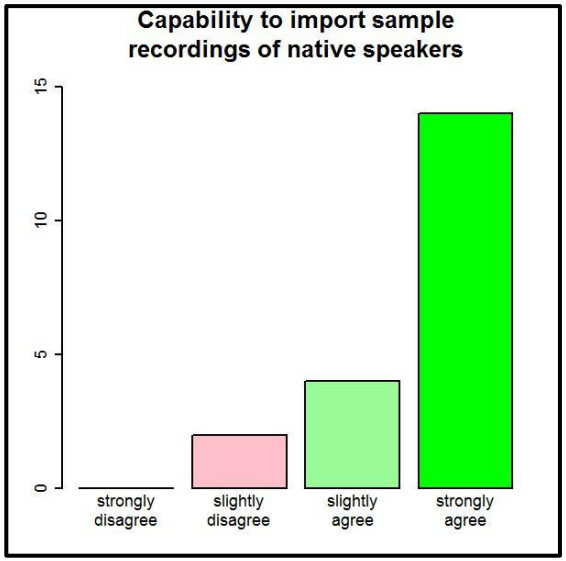


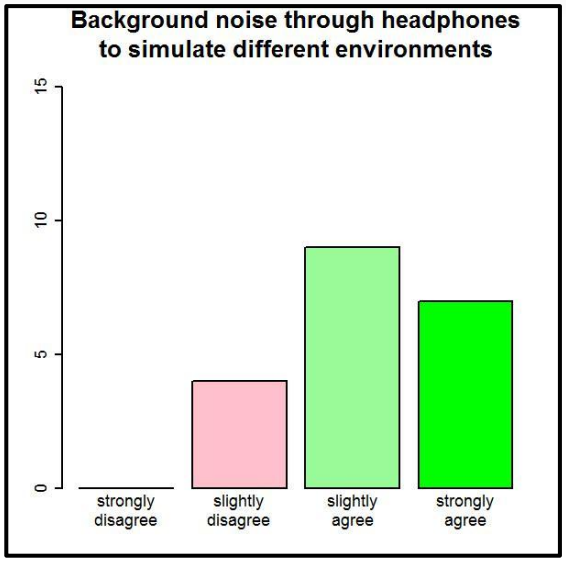


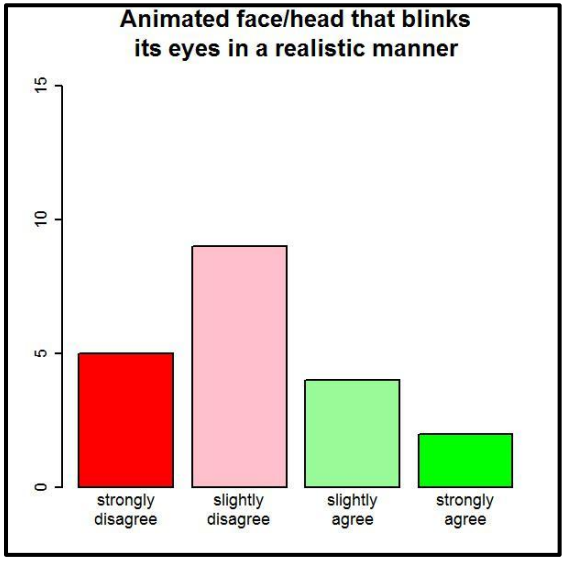


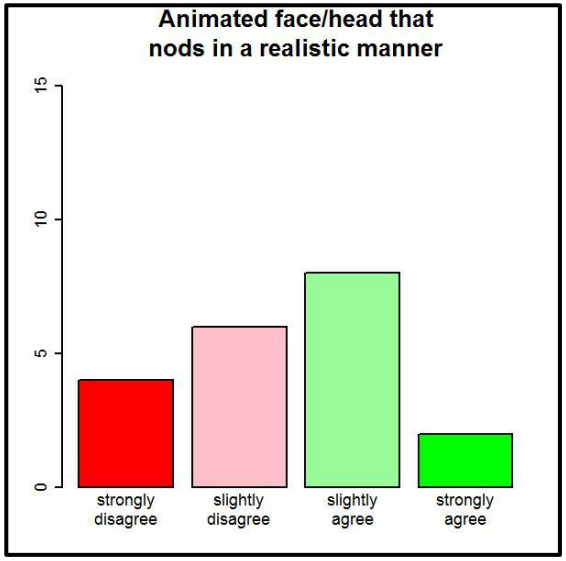
Fluidity: desirable features

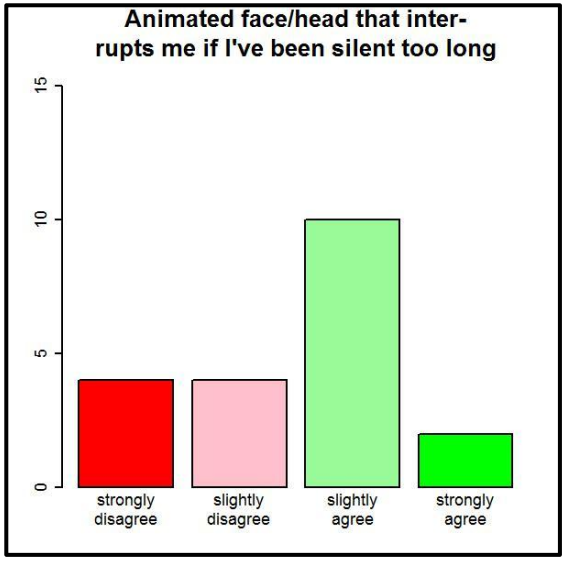












Fluidity: user comments

- 「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.*

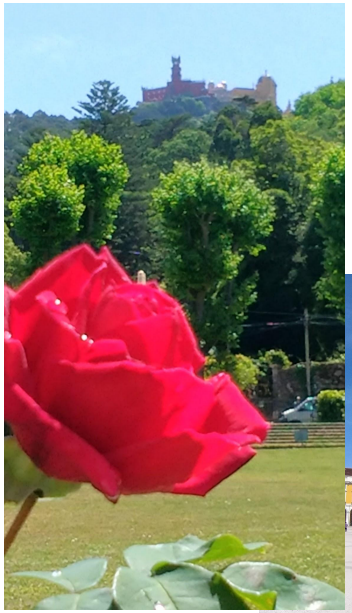
Putting things together...

- Different audiences have different perceptions of fluency
  - Native vs. nonnative
  - Shared native language vs. non-shared native language
- Audience description is critical aspect of language program design (cf., CEFR guidelines)
  - Emphasize articulation rate?
  - Emphasize minimal silent pauses?
  - Emphasize productive use of filled pauses?
- Various utterance fluency profiles are needed …
- To guide learners with possibly different needs

Goals during this year

- Implement profiles in Fluidity
- Test them with Portuguese (and other) students
- Return to Japan to use with students there.
- (And distribute application widely, of course.)

MUITO OBRIGADO!



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