

2015-06-01

Syllable Circles for Pronunciation Learning and Teaching

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Recommended Citation

Whipple, J. B., Cullen, C., Gardiner, K. (2015) Syllable Circles for Pronunciation Learning and Teaching, *English Language Teaching Journal (ELT)*, Oxford University Press. doi:10.1093/elt/ccu094

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1 **Syllable Circles for Pronunciation Learning and**
2 **Teaching**
3

4 **John Whipple, Charlie Cullen and Keith Gardiner**
5

6 *Syllable Circles is an interactive visualization representing prominence as a feature*
7 *in short phrases or multi-syllable words. They were designed for Computer Aided*
8 *Pronunciation Teaching as a part of English Language Teaching. This study*
9 *explores the question of if and how interactive visualizations can affect English*
10 *Language Learners' awareness of prominence, or stress, in English pronunciation.*
11 *The study followed seven learners and three teachers. Think-aloud protocols, notes*
12 *from direct observation and interviews of two groups allowed for six streams of*
13 *data. It was found that interactive visualizations of syllable circles facilitate*
14 *noticing prominence. Learners and teachers believed interactive visualizations*
15 *were a useful means for presenting prominence and other suprasegmental*
16 *features and would be valuable learning and teaching resources.*

17 **Changes in Pronunciation Learning Objectives**
18

19 *We are now at a point where most L2 teachers recognize that there is*
20 *nothing wrong with having an accent, and that intelligibility and*
21 *comprehensibility should be the goals of L2 speakers, not native-like*
22 *status. Technology is advancing; there is a real role for... other sorts*
23 *of practice opportunities, informed by research. (Derwing, 2009)*
24

25 Intelligibility should be primary goal for English language learners and teachers
26 (Levis 2005; Munro and Derwing 2011). To have a greater impact on
27 intelligibility, research suggests using methods and tools to focus learning on
28 suprasegmentals: features such as *rhythm, intonation, syllable stress* and
29 sentence-level *word stress*.
30

31 *Stress* in both sentences and words will be referred to in this study as
32 *prominence*. Noticing *prominence* is fundamental to thinking about
33 suprasegmental features. Unfortunately, like other suprasegmental features,
34 prominence is not visible in standard written English and is noted in the
35 International Phonetic Alphabet (IPA) as mere punctuation despite its impact on
36 intelligibility. To help learners understand what makes one speaker more
37 intelligible than another, teachers can address the perception, conceptualization
38 and description of suprasegmentals.
39

40 Thoughtful teaching and the use of tools like the IPA aid pronunciation learning.
41 Despite the systematic presentation of the IPA leading to a perceived
42 teachability, phonetic alphabets like the IPA do not, unfortunately, focus *visually*
43 on suprasegmentals in a way proportionate to their impact on learner
44 intelligibility.
45

1 For best effect on intelligibility, learners should be primarily affected by the
2 impact of suprasegmental features (Anderson-Hsieh, et al 1992; Hahn 2004;
3 Levis 2005).

4

5 **Noticing Prominence**

6

7 The faculties of learners and teachers to notice speech phenomena can have an
8 effect on learner intelligibility (Couper 2006). Hahn's study demonstrates that
9 'primary stress' or prominence is a worthwhile learning target because of its
10 significant effect on intelligibility (2004). She found that an unusual use or
11 absence of prominence was a key factor in speakers being rated as less
12 intelligible.

13

14 Schmidt's *Noticing Hypothesis* posits that any learning must be preceded by
15 either conscious or unconscious noticing (1990). Whether conscious or
16 unconscious, the learner's observation of suprasegmental features makes an
17 impact on their intelligibility.

18

19 If prominence is given more attention visually, learners may be enabled to notice
20 prominence. Once noticed, awareness and stronger criteria for acceptable
21 production can facilitate greater intelligibility.

22

23 **Computer Aided Pronunciation Teaching**

24

25 Munro and Derwing outline how intelligibility-focused pronunciation teaching is
26 progressing and is facilitated by technology (2011). They note the utility of
27 recordings, speech analysis and speech visualization while agreeing that more
28 appropriate learning objectives and tools are needed.

29

30 Grantham-O'Brien describes how multimedia technology has been used in
31 descriptive language teaching. She synthesizes a progression of developments to
32 suggest guidelines for future applications of multimedia technology (2011).

33 These echo Levis in his call for pronunciation learning to mean increasing
34 intelligibility (2005). This includes creating tools to give simple feedback and
35 resources designed expressly for language learning.

36

37 Their findings also reflect the idea that language learning is not a linear process.
38 DeBot suggests that language learning and acquisition is perhaps best described
39 through Dynamic Systems Theory, implying that language learning needs
40 'external resources' like 'spatial environments to explore' and 'internal
41 resources' like conceptual knowledge of key concepts and terms (DeBot, et al
42 2007). However, few external resources dealing with suprasegmentals are
43 available. The teacher is left to address these needs alone to in the absence of
44 tools clearly requested in research and practice.

45

46 Attempts have been made to use standing technologies for Computer Assisted
47 Pronunciation Teaching. One example tool is PRAAT, used memorably by Brett

1 (2004). PRAAT is a freely downloadable, powerful speech analysis and
2 visualization tool. His study clearly described how PRAAT helped learners
3 further understand discrete segmental features. Though somewhat successful,
4 the feedback was difficult to interpret without certain theoretical grounding.
5 Brett reminds readers that PRAAT was designed for speech scientists not
6 language learners and teachers. Its feedback remains complex and perhaps not
7 suited to language learning.

8
9 Visualizations of speech samples designed to be clear, to be memorable and to
10 facilitate discussion may help learners do what they do in classrooms already:
11 discover, share, discuss and try out their observations. Multimedia tools
12 designed to facilitate learners noticing prominence should positively affect the
13 learners' 'internal abilities' by giving them an 'external resource', a 'spatial
14 environment', to explore.

15
16 This should facilitate teachers as they help learners to notice, examine, discuss
17 and socially explore features of speech shown to positively affect intelligibility.

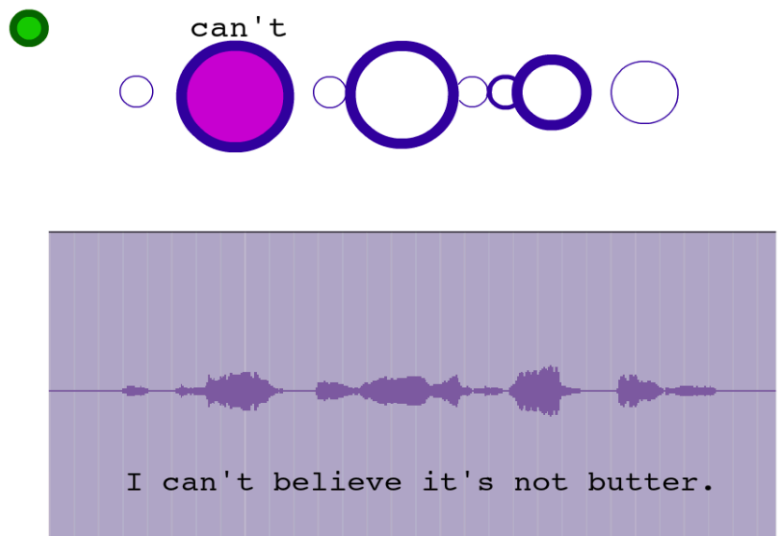
18 **Syllable Circles: Interactive Visualizations to Help Learners** 19 **Notice Prominence**

20
21 Three interfaces or components were designed to demonstrate syllables and
22 prominence visually and interactively for learners.

23
24 Component 1 was based on a single audio recording of a short phrase. The
25 recording was divided into syllable-sized audio segments. Each syllable segment
26 was represented visually through circular buttons of different sizes. A click on
27 any button played the syllable it was drawn from in the short phrase. The
28 buttons were aligned on screen in sequence. Larger buttons for more prominent
29 syllables and smaller for less prominent. Circle size related to three factors:

- 30 1. Its duration;
- 31 2. Its pitch change;
- 32 3. Its volume.

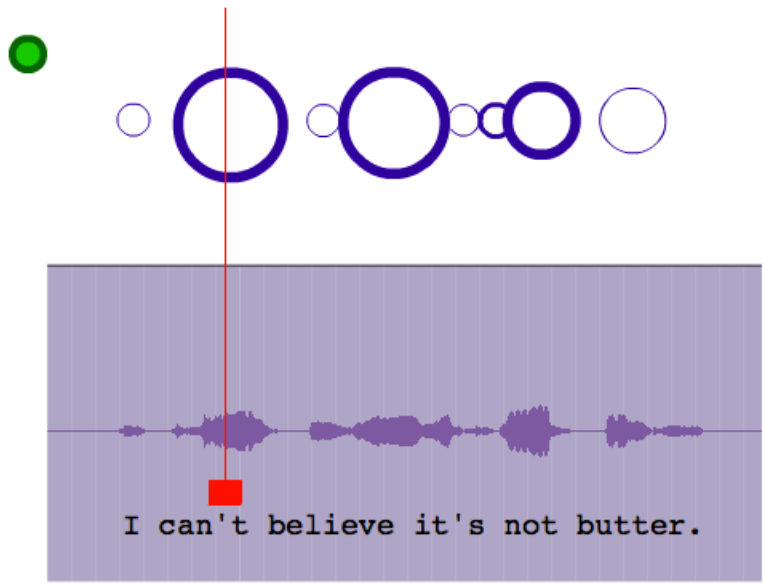
33
34 The placement of the syllable circles matched a computer-generated waveform
35 of the recording and text. The final interface appeared as below and could be
36 enlarged to fill a full screen:



1
2 **Figure 1 Component 1: Mouse over second syllable circle**

3 Each syllable circle button functioned interactively to avoid explicit instructions.
4 When the mouse was rolled over the circle, the circle filled and the
5 corresponding letters of the word or phrase appeared above it (see Figure 1).

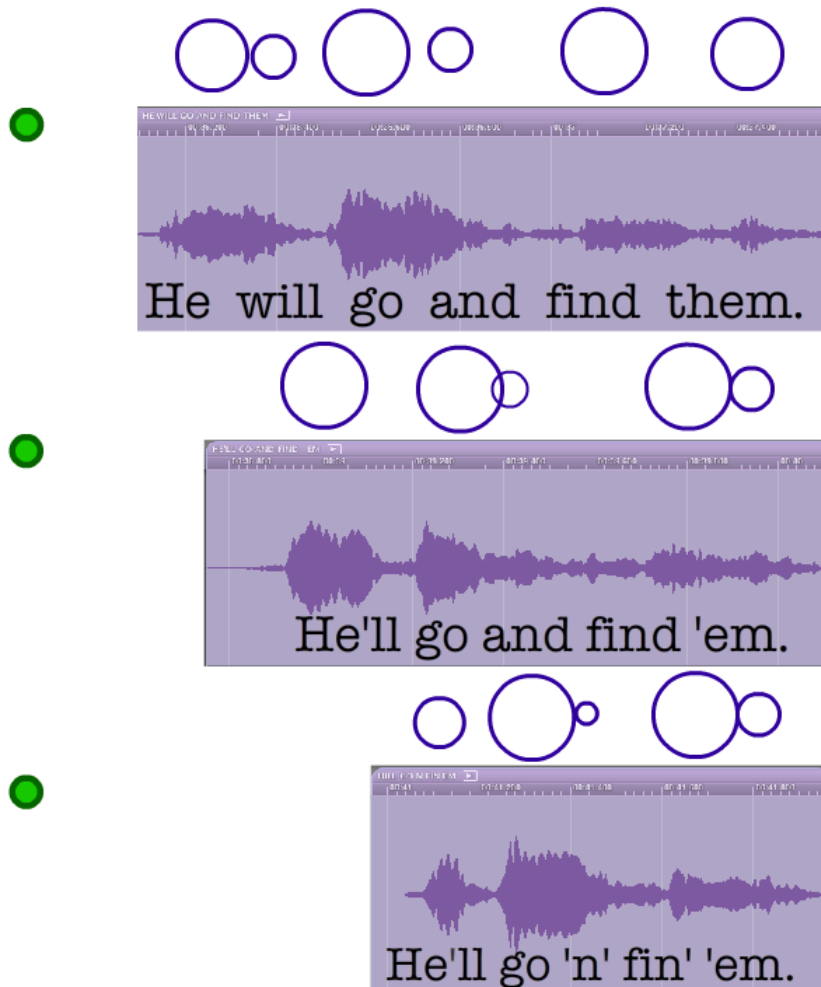
6
7 The offset button (upper left corner) played the entire phrase and cued a
8 playhead to move horizontally across the three vertically aligned elements: the
9 syllable circles, the waveform and the text. The movement of the playhead
10 matched the progress of the voice through the sample. It associated the elements
11 for the user and reduced the need for identifiers or explanations (see Figure 2).
12



13
14 **Figure 2. Component 1: Playhead moving across the three visual elements simultaneously**

15
16 Component 2 and Component 1 were both created in Adobe Flash. Component 2
17 was designed to facilitate comparison between instances of the same phrase
18 spoken by the same speaker. It demonstrates decreasing formality and

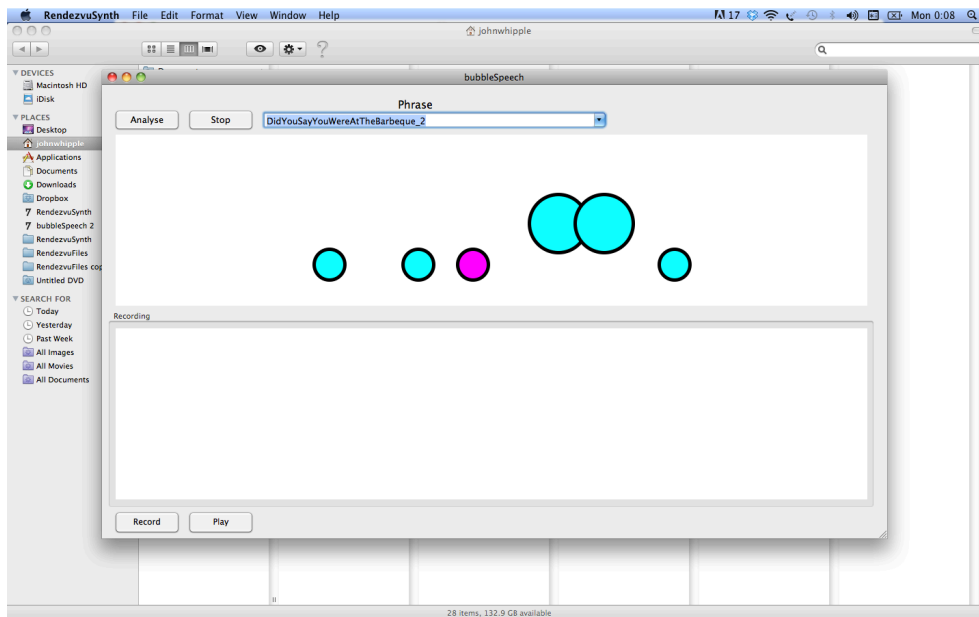
- 1 increasing speed. Some irregular spellings were used to demonstrate and
- 2 emphasize the elision of some sounds. See Figure 3 below.



3
4 **Figure 3. Component 2: Multiple Samples allow the user to compare different instances of the same**
5 **phrase spoken by the same user.**

6 Component 3 was created in partnership with the Digital Media Centre in Dublin
7 Institute of Technology. It created syllable circles automatically through a
8 program using a speech analysis framework adjusted to detect syllables based
9 on the presence of vowel sound indicators. Once detected, the framework sends
10 data to an interface, automatically rendering interactive syllable circle
11 visualizations.

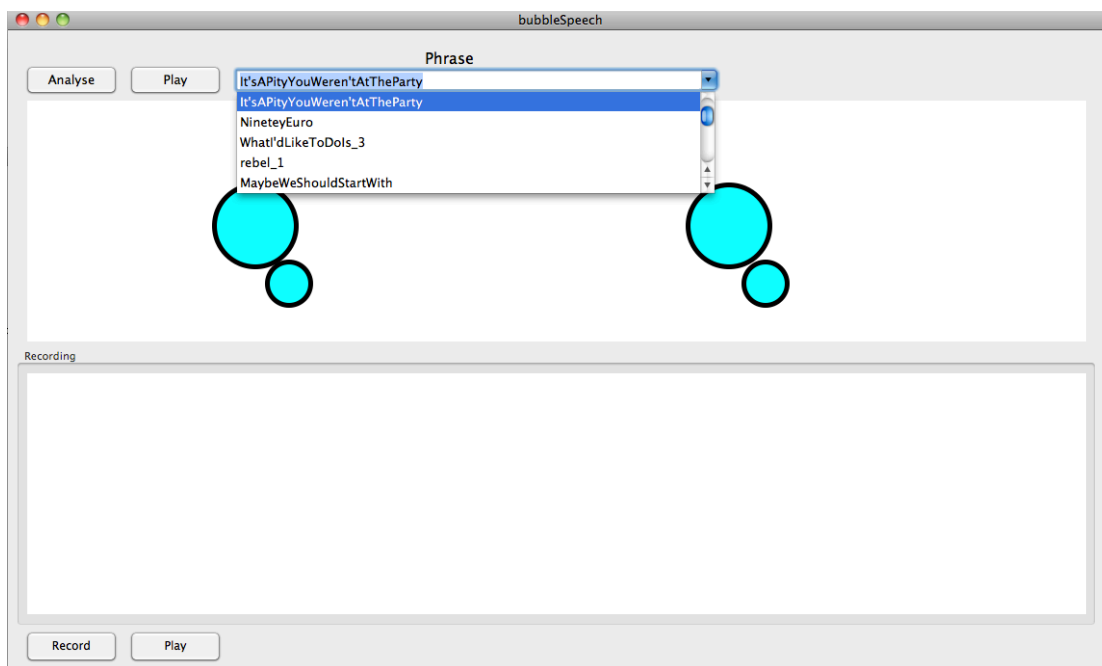
12
13 Fifty phrases were pre-recorded to be available for the study. The same
14 interactive syllable circle concept featured, with size indicating prominence and
15 each circle played its respective syllable-sized audio segment when clicked. The
16 circles filled with a new color to indicate they were being sounded. They were
17 positioned sequentially, but prominent circles were placed higher than less
18 prominent ones. See below:
19



1

2 **Figure 4. Component 3: A full phrase being played with the third syllable sounding**

3



4

5

6

7 **Figure 5. Component 3: Displaying 'Sorry... how much?'** Note the sample phrase menu for the next
 8 phrase to be displayed and 'Record' and 'Play' buttons for the lower display space.

7

8

9

10

11

12

13

Component 3 some presented drawbacks and benefits. It did not reliably recognize all syllables in the phrase and frequently failed to recognize the final syllable in some longer phrases. It was missing three significant visual elements: 1) the text, 2) the waveform images and 3) the playhead. Notable advantages included the number of samples available; the speed of creation; the potential for the learner to record, analyse and compare their own samples.

14

15

16

Presented with Components 1 and 2, the set was deemed to present a robust sample of the syllable circle concept as a worthwhile intervention for a case study investigating how learners may be affected.

1 **Case Study**

2
3 A qualitative case study was designed to determine *if* and *how* users feel they
4 were affected by interactive visualizations of syllable circles illustrating
5 prominence. As an educational case study the research relied on the views of the
6 participants (Cresswell 2008). Its findings should be combined with relevant
7 findings from similar studies of Computer Aided Pronunciation Teaching to lead
8 to 'fuzzy' generalizations about educational practice as suggested by Bassey
9 (2006).

10
11 Seven learners and three teachers explored the components and were
12 subsequently interviewed to determine its potential for pronunciation learning.
13 The study was carried out in a self-access environment in a private English
14 language school.

15
16 Ethical procedures for university study were followed. Permission and informed
17 consent were obtained from the school and the participants individually.

18
19 The seven learner-participants were between 18-35 and had an English
20 proficiency level of B1 on the Common European Framework of Reference
21 attested by their school placement procedures. The three teacher-participants
22 had all been teaching for four years or more. Each had achieved or was studying
23 for a higher qualification in English Language Teaching.

24
25 Step 1: Each participant had a 10-minute introduction to the three components.

26
27 Step 2: The researcher audio recorded 20-minute 'think-aloud' exploration for
28 transcription providing the first data stream. Each participant engaged with the
29 three components using the 'think-aloud' protocol. They were invited to spend
30 as much of their time with any of the components as they wished and to move
31 freely amongst the them. The researcher avoided interference but answered
32 questions when directed at him and reminded the user of the think-aloud
33 protocol if they began working silently or used only one component.

34
35 The researcher took notes throughout providing a second data stream,
36 observation notes.

37
38 Step 3: The researcher held a 20-minute semi-structured interview with each
39 following Step 2. These interviews were recorded and transcribed, providing the
40 third data stream. The questions were open-ended to seek descriptions of the
41 users' experiences. Questions for the teacher interviews addressed teaching and
42 learning practice (see **Appendix 1**). Accordingly teacher interview data was
43 separated from learner data.

44
45 The researcher continued taking notes through this experience adding to the
46 observation notes.

47
48 Research with each participant lasted approximately 60 minutes. Three data
49 streams resulted for each participant: see table below.

1

<i>Participants</i>	<i>Activity</i>	<i>Time</i>	<i>Data Stream</i>
Learners	Think-Aloud	20-30 Minutes	Recording Transcripts
	(Entire Experience)	Continuous	Researcher Notes
	Semi-Structured Interview	20-30 Minutes	Recording Transcripts
Teachers	Think-Aloud	20-30 Minutes	Recording Transcripts
	(Whole Experience)	Continuous	Researcher Notes
	Semi-Structured Interview	20-30 Minutes	Recording Transcripts

2

Table 1 Summary of Data Collection

3

4

Transcripts from the participants were anonymized, coded and themed to reveal data leading to findings of the research question.

5

6

The research question was as follows:

7

Do interactive visualizations of speech samples help learners notice prominence as a feature of English speech? If so, how?

8

9

10

11

Data Analysis

12

13

Six data streams were collected from the study. The purpose, form and a description of the analysis of these streams are illustrated below in tabled examples.

14

15

16

Purposes, Form and Analysis of Think-Aloud Transcripts

17

Learner-Participants (Px) and Teacher-Participants (Tx) used a think-aloud protocol as they explored the components to render insights regarding the individual cognitive processes of each participant and give some evidence about how the user interacted with the components. Audio recordings were made. Each was transcribed, the statements within were coded and finally and finally the codes revealed themes as in the samples below:

18

19

20

21

22

23

<i>Transcript</i>	<i>Codes</i>	<i>Theme</i>
P5: [Repeats short recordings 10x] The same? Hmm. [Repeats short recordings 15x] Ok. Ok, this one? Oh, 7?	Repetition in Observation; Observation-Hypothesis-Experiment; Learner engagement	Value of recordings
P6: And now I know the tense (P6's word for prominence)... So the tense is on 'can't' and the 'lie' of 'believe' and 'it's not butter'. And do it again. (clicks) Recording: I CAN'T BELIEVE IT'S NOT BUTTER. L6: I can't believe it's not butter. And I've got the rhythm of the sentence...	Perceived possible learner benefits; Forecast prominence patterns; Hypothesis statement	Perceived Benefits

P3: It's very short like when I speak with my friends. And we can hear, but if I think if I listen, I don't understand, it's impossible. It's too fast for me.	Comparison with L1; Comparison with own experience; Native speed as problem	Comparison; Own experience; Own concepts
T3: (The concept of prominence) is there. It's there for them.	Benefits of visual persistence: Teacher ideas; Value of visualizations;	Creative and critical engagement

1 *Table 2: Samples of Think-Aloud Transcripts with Codes and Themes*

2

3 The initial coding process suggested a great variety of instance specific codes.
4 Readings and re-readings led to an increased familiarity with the data. Gradually
5 certain codes appeared more frequently with instance specific codes being
6 revisited to see if they matched codes that had emerged after initial readings or
7 to see if they shaped the developing themes. Overlap indicated themes. These
8 led to evidence for the findings.

9 **Purposes, Form and Analysis of Observation Notes**

10 The observation notes were a valuable record of the users' experiences,
11 expectations, subjective assessments and unspoken reactions.

12

13 The notes on each page were transferred to a spreadsheet to aid analysis.
14 Subsequently the notes were summarized and grouped with reference to
15 similarities of themes that emerged from the transcripts.

16 **Purposes, Form and Analysis of Semi-Structured Interviews**

17 Following the observations each learner and teacher was administered a semi-
18 structured interview lasting approximately 20 minutes. Five questions were
19 asked.

20

21 The purpose of the semi-structured interviews was to allow the users
22 opportunities develop a descriptive discussion of their views and experience.
23 The questions allowed the opportunity to discuss the interface as a learning aid,
24 comparing its content and utility to previous learning experiences.

25

26 After coding all of the content from the interview transcripts, fifteen themes
27 were revealed including the following included as examples:

28

<i>Transcript</i>	<i>Codes</i>	<i>Theme</i>
P1: The circles show me how each word you have to say- you have to enunciate- each word because (...) they are together and some of them they are not together and they show how...	Circle size as prominence guide; Linking issues; Written vs Spoken English; Learner experience shaping concepts;	Concepts noticed
P4: I think it's more about speaking... because I don't really learn about the rules for example, for a word with two syllables, three. So, it's really	Importance of listening; Unconscious learning; Lack of guidance/instruction; Need for speaking work	Learning difficulties

by listening to people that you can just pick up this kind of thing.		
P5: If we realise that's the problem, we can forecast this one. So I recommend to record fast and compare and fix and find the faster problem...you know what I mean?... If we know what's the difference, we can forecast more... the stress.	Critical thinking; Perceived possible learner benefits; Forecast prominence patterns; Hypothesis statement; Own preferences	Perceived Benefits

Table 2: Samples of Learner Interview Transcripts with Codes and Themes

Teachers were asked a separate set of questions to inform as experts on the learner's process and the utility of the components as teaching tools. The teacher data revealed numerous codes from which three major themes emerged. These were as follows and are reflected in the Findings:

<i>Transcript</i>	<i>Code</i>	<i>Theme</i>
T1: I think teaching sentence stress for people to give... certainly for visual learners it'd be very good .. 'cause eh.. it's sometimes very difficult even just with underlining things on the board...	Design approval; Learner preferences; Teaching challenges for pronunciation teaching;	Teaching and learning issues around pronunciation
T3: I've never even considered visualizing it, and I don't think my students would... It's fantastic.	Teacher/learners wouldn't visualize; Design approval; Demonstrate prominence	Benefits and potential for teaching and learning
T3: Let's say I was doing a reading or there's a potentially blocking piece of vocabulary and I could type in ... and suddenly you have all of these images	Overlap for utility; Teacher ideas	Creative and critical engagement

Table 3: Significant Teacher Interview Themes

Findings

Primary finding

The purpose of this investigation was to determine *if* and *how* interactive visualizations of speech samples help English language learners notice prominence. The data strongly suggests that interactive visualizations of syllables do.

They do so memorably by facilitating observation, hypothesizing and experimentation while enabling them to notice other speech phenomena.

Secondary findings from learner data

Data analysis leads the researcher to suggest that use of the components allowed learners:

- 1 1. To recognize prominence independently through comparative size
- 2 and interactivity;
- 3 2. To compare expectations, the sample and own production;
- 4 3. To conceptualize a shared, persistent, visual symbol of a significant,
- 5 invisible phenomena;
- 6 4. To notice linking and elision.

7 The use of the components also:

- 8 5. Provides conceptual clarity for the learner;
- 9 6. Makes the concept memorable visually;
- 10 7. Provides the learner a welcome laboratory for testing and
- 11 demonstrating observations;
- 12 8. Enables an Observe-Hypothesize-Experiment cycle promoting various
- 13 discoveries and questions that can be used as starting points for
- 14 various lessons.

15 **Secondary findings from teacher data**

16 Teachers confirmed learner views based on their previous experience using
17 Computer Aided Pronunciation Teaching and their work with the components.

18 They found that the components

- 19 1. Provide a useful way to illustrate prominence;
- 20 2. Enhance learners' abilities to compare speech phenomena;
- 21 3. Facilitate learners' efforts in noticing and conceptualizing syllable
- 22 stress, linking phenomena, weak forms and typical phonological
- 23 features of lexical chunks.

24
25 Teachers believe learners want to improve their pronunciation. They confirm
26 that it remains difficult to suggest self-study Computer Aided Pronunciation
27 Teaching resources. Explicit pronunciation teaching is currently central to
28 raising learner pronunciation awareness.

29 **Conclusions and possibilities from teacher data**

30 **Teachers**

31 Teachers demonstrated engagement with the components through praise,
32 criticism, ideas and requests for further samples. Below are some quotes from
33 the teachers:

34
35 'If you had something like this (a similar affordance)... before class, you
36 could analyse the stress, the intonation... that would make you think more
37 deeply about incorporating pronunciation.'

38 'This would be quite good... to demonstrate clearly... how we reduce the
39 number of syllables in each of the sentences. I think this is good. Very,
40 very clear.'

41 'This is a demonstrative application. You're presenting... It helps them
42 notice.'

43 'I could have used this in my class this morning.'

44

1 **Learners**

2 The learner-participants displayed additional interest in noticing and
3 recognizing other taught pronunciation phenomena in addition to prominence.
4 They replayed syllable-level recordings a surprising number of times and
5 seemed particularly struck noticing linking phenomena. None of the learners
6 reported having access to this type of functionality previously.

7

8 In the semi-structured interviews, participants explained their thinking and
9 learning frequently with the use the interface itself as a tool to illustrate their
10 observations:

11

12 (W)hen people also speak very fast... it's different...it's (a) different
13 sentence. First, I think (the slowly spoken sample is) for me: 'I will go and
14 find them'.

15 (Learner clicks) HE WILL GO AND FIND THEM.

16 So, it's very slowly with a right word. ...The second sentence, it's a short
17 sentence with the verb 'will' is not written, just a double 'L'. 'I'll go an' find
18 'em'.

19 (Learner clicks) HE'LL GO AND FIN' 'EM.

20 And the verb is very, very short. I think it's like an expression when
21 English people speaks very fast with his friends. I don't know how in the
22 conversation, it's like made in French. ... it's not my real language, so the
23 words are different from my language and it's very short like when I
24 speak with my friends. And we can hear, but if I think- if I listen, I don't
25 understand, it's impossible. It's too fast for me.

26

27 The level of control afforded to the learner by the interface presented an
28 opportunity to engage in an Observe-Hypothesize-Experiment cycle as suggested
29 by Lewis (2008). The learner naturally and spontaneously listens, hypothesizes
30 internally and experiments in speech. This cycle was observed with each learner.

31

32 The learner highlights one problem which constantly affects all language
33 learners: the need to examine what is being said while simultaneously gleaning
34 lessons about how to pronounce phrases intelligibly and deal with meaning and
35 culture. Learners need space and time to create their internal resources and
36 conceptual knowledge.

37

38 Perhaps the most welcome features were the degree of control over the speech
39 sample, its visual navigability and persistence on screen.

40

41 Another advantage seemed to be the empowerment to share and demonstrate
42 their observations because of the sample's navigability and persistence.

43

44 Comparison, the social act of description and discussion about these
45 observations, reflection contribute immensely to the learning process and need
46 fostering. An example from Learner 1 demonstrates how the interface enabled
47 the learner to observe. They goes on hypothesize and share their findings
48 regarding. The learner used Component 2 actively in conversation to illustrate
49 their findings.

1
2 Eh, because the circle are, I don't know, something like locked or...
3 *Yeah, and what does that mean to you?*
4 It mean there is a liaison, I have to contract them. Go-an'. Not say 'go and',
5 say 'go-an'.
6 *Good.*
7 Emm.
8 (Learner clicks) HE'LL GO AN' FIN' 'EM.
9 He'll go an' fi' 'em. But there is a difference of pronunciation if I go to the
10 first sentence.
11 (Learner clicks) HE WILL GO AND FIND THEM.
12 'He will go and find them.' So, maybe when you speak with your friend,
13 you say: 'He'll go and fin' 'em'. And of course, if you want to have a good
14 pronunciation, it's better to say: 'He will go and find them'.
15
16 The learner used the component spontaneously to describe a precise finding
17 regarding pronunciation much as teachers use examples in text to illustrate
18 grammar and lexis. This was observed very frequently.

19 **Cautions and Caveats**

20 A warning should also be taken: in the example above the learner says 'have to'.
21 Do they regard the recorded samples as ideal examples? They are not ideal. They
22 are samples. Discussion should be fostered for learning and assistance is needed
23 in analysis. There is a need for guidance on how to interpret the significance of
24 the sample: perfect or passable, target or topic of discussion? Language learning
25 exists in a social context. This tool does not provide the all the guidance needed.
26 Tools are not teachers, but tools can help teachers and learners to observe their
27 language more clearly.
28

29 A halo effect may have been created by the presence of the researcher or the
30 engagement in the think-aloud protocol. The attention and questions of the
31 researcher, as well as the think-aloud protocol, should be noted as much as the
32 persistence and navigability of the design as learning aids. However, the
33 technology affords the learner notable new faculties.

34 **Recommendations for development**

35 This case study had the limited goal of examining how using this intervention
36 might help learners notice prominence in order to affect intelligibility. Though
37 designed for this specific purpose the ancillary benefits and themes revealed
38 show potential for further exploration. As teachers and learners work to develop
39 ways to explore their language it is hoped that Syllable Circles may be
40 considered as an example for future Computer Aided Pronunciation Teaching
41 design.
42

43 **Appendix 1**

44 **Learner Interview Questions**

- 45 1. Have you ever used worked on your pronunciation? (Please describe.)
- 46 2. What did the circles mean, show or represent to you?
- 47 3. What did you notice while you were working with the application?

- 1 4. Can you describe any changes in how you think about how we use
- 2 syllables in English?
- 3 5. What kind of questions do you have now?
- 4

5 **Teacher Interview Questions**

- 6 1. Could you briefly describe how pronunciation teaching fits into English
- 7 Language Teaching today?
- 8 2. Learning situations are very different: one-to-one, mixed language
- 9 groups, single language groups: How should self-study pronunciation
- 10 work be approached in ELT?
- 11 3. What should be the main focus of activity in individual learner
- 12 pronunciation work in your opinion? What tools do they use?
- 13 4. What kind of tools can be you used to help students in become more
- 14 aware of their pronunciation? How could applications like this be made
- 15 helpful?
- 16 5. What are your most successful learners doing about their pronunciation?
- 17
- 18

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5 Word count

6 Title and Abstract: 129

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