PRESENTATION/POSTER

# AN ANALYTICAL INSTRUMENT FOR EVALUATING COMPUTER-ASSISTED PRONUNCIATION TEACHING SOFTWARE, WEBSITES, AND MOBILE APPS

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Computer-assisted pronunciation teaching (CAPT) offers many potential benefits—a private, stress-free learning environment; virtually unlimited input; practice at the student's own pace; individualized, instantaneous feedback through Automatic Speech Recognition (ASR); and visual acoustic and articulatory displays. Many CAPT programs, websites, and mobile apps have been created in recent years. Regrettably, however, CAPT software does not always measure up to its potential. Furthermore, many L2 teachers and learners, not familiar with the full range of CAPT possibilities, may not be aware of what features to look for in a CAPT product. This paper shares a remedy to this problem—a comprehensive set of criteria for analyzing and evaluating CAPT software, websites, and mobile apps. Utilizing an easy-to-use checklist, as well as Likert-scale and open-response items, of features that potential CAPT users should look for in software, this two-page instrument guides teachers and learners evaluating CAPT programs to consider variables and criteria recommended by pronunciation and CALL experts.

## THE PROMISES AND LIMITATIONS OF CAPT

Pronunciation teachers and learners have long been enticed by the potential of computer-assisted pronunciation teaching (CAPT). Over 15 years ago, Neri, Cucchiarini, Strik, and Boves (2002, p. 441) stated that CAPT "can be beneficial to second language learning as it provides a private, stress-free environment in which students can access virtually unlimited input, practice at their own pace and, through the integration of Automatic Speech Recognition (ASR), receive individualized, instantaneous feedback."

Levis (2007) later made a similar point:

> The use of computers is almost ideally suited to learning pronunciation skills. Computers can provide individualized instruction, frequent practice through listening discrimination and focused repetition exercises, and automatic visual support that demonstrates to learners how closely their own pronunciation approximates model utterances. (p. 184)

More recently, others (Chun, 2013; Fouz-González, 2015) have described promising CAPT tools, such as visual acoustic displays (i.e., waveforms, spectrograms, pitch contours, and formant data), visual articulatory displays (i.e., sagittal section diagrams and still and video images of a speaker's mouth and lip movements), and automatic speech recognition (ASR).

Today, increasing numbers of language learners and teachers are coming to rely on websites and mobile apps to help them improve their English language skills (Rosell-Aguilar, 2017, p. 243). A

large number of online programs have been developed with the goal of helping English language learners (and their teachers) with various aspects of English—including pronunciation.

Regrettably, not all these websites and apps are as helpful or effective as they could be. For this reason,

> Teachers and learners should not be seduced by the strong appeal of the marketing done by publishers. Instead, it is necessary to analyze English as a Foreign Language and/or Second Language (EFL/ESL) pronunciation teaching software programs as to their potential for developing English pronunciation. There is an unquestionable need to analyze these programs from a critical perspective using pedagogically coherent and technically elaborated criteria. (Martins, Levis, & Borges, 2016, p. 142)

O'Brien and Levis echo this warning: "Many of the commercially available products are often neither pedagogically sound nor informed by research" (2017, p. 1). Neri, et al. (2002, p. 441) also laud the "wealth of CAPT systems" available but caution,

> When examined carefully…the display of products may not look entirely satisfactory. Many authors describe commercially available programs as fancy-looking systems that may at first impress student and teacher alike, but eventually fail to meet sound pedagogical requirements.…These systems, which do not fully exploit the potentialities of CAPT, look more like the result of a technology push, rather than of a demand pull. (p. 442)

More recently, Kaiser (2017, slide 45) has noted that instruction is often based more on "what is easier to program or what will 'sell' the app than what is best pedagogy." Rather than giving primacy to proven pronunciation-teaching/learning principles and procedures, "many apps have been developed with more attention to appearance and flash" (Yoshida, 2018, p. 208).

In sum, while initially offering marvelous promise, CAPT software has not always delivered on that promise. Instead, it has frequently failed to embody the ideals envisioned for it.

## CHARACTERISTICS OF IDEAL CAPT PROGRAMS

Many experts have made recommendations for the design of high quality CAPT software. For instance, considering not only the pedagogical but also the technological aspects of CAPT software, Neri, et al. formulated a set of recommendations for model CAPT programs:

> Learning must take place in a stress-free environment in which students can be exposed to considerable and meaningful input, are stimulated to actively practice oral skills and can receive immediate feedback on individual errors. Input should pertain to real-world language situations, it should include multiple-speaker models and it should allow the learner to get a sense of the articulatory movements involved in the production of L2 speech. Oral production should be elicited with realistic material and exercises catering for different learning styles, and should include pronunciation of full sentences. Pertinent and comprehensible feedback should be provided individually and with minimum delay and

should focus on those segmental and suprasegmental aspects that affect intelligibility most. (2002, p. 449)

Today, CAPT users are still hoping for programs that have all (or even most) of the above features—especially automatic speech recognition (ASR) that will "recognize everything the user says, point out those areas that are most problematic (depending on the user's priorities, be it intelligibility, comprehensibility or accuracy), and then offer explicit feedback indicating how to improve" (Fouz-González, 2015, p. 324). Such instantaneous, individualized, targeted feedback is desirable as it will lead to greater learner autonomy, responsibility, and self-monitoring on the part of L2 pronunciation learners. Discussing the use of ASR in CAPT, McCrocklin (2016) made the case that students should become autonomous learners of pronunciation by developing skills and using strategies that will enable them to practice pronunciation on their own and not rely on a teacher for pronunciation training. For this reason, she praised online resources as tools that can potentially "promote autonomy by enabling experimentation through self-access work outside of class while also providing immediate feedback to learners" (p. 27).

Putting all these desirable criteria together forms an impressive CAPT-software wish list: A stress-free learning environment, meaningful and realistic input, active practice beyond the word level, instant and individualized corrective feedback that is targeted on specific perception or production problems, multiple speaker models, articulatory explanations and visualizations, allowances for different learning styles and rates, focus on the aspects of pronunciation—both segmental and suprasegmental—that are most important to intelligibility, and the promotion of greater autonomy and more effective strategy use on the part of L2 pronunciation learners.

## CURRENT CAPT REALITY

The ideal CAPT characteristics listed above are clearly desirable, but in the real world today pronunciation-focused websites and mobile apps rarely measure up to all these criteria and expectations. Often a significant gap exists between current, research-based pronunciation theory and pedagogy and actual CAPT applications. Lamentably, many appear "suspiciously like traditional, drill-oriented pedagogy in new clothing" (Levis, 2007, p. 185). Kaiser (2017) recently analyzed 30 L2 pronunciation teaching/learning apps and found that, of the 30 apps, 22 (73.3%) relied heavily on a simple listen-and-repeat instructional approach and provided no feedback to learners regarding the accuracy of their production. Only a few apps provided visual feedback in the form of spectrograms. Regarding the eagerly anticipated, long-promised benefits of ASR, Kaiser's (2017) analysis determined that the few mobile apps he examined that employed automatic-speech-recognition provided simplistic, dichotomous "correct" or "incorrect" feedback that was not necessarily accurate. From this and other sources of evidence, it appears that in spite of the great potential that ASR holds for providing automatic feedback on learners' pronunciation, it…

> Needs to improve substantially before learners can use these systems autonomously and rely entirely on their judgments. The effectiveness of these systems decreases significantly when dealing with non-native speech…and ASR ratings do not always correlate with those by human raters.…In spite of advances in the field, an acceptable level of reliability is only guaranteed when the tasks are simple and utterances are kept to a restricted set from which

students select a response…something that limits the usability of this technology for spontaneous practice. (Fouz-González, 2015, p. 328)

Fouz-González (2015) also points out that when used with L2-accented speech, ASR typically produces "numerous false alarms and low rates of correct detection," resulting in an experience that "may be quite frustrating for users if mistakes are not detected or are detected incorrectly." Further, "once learners suspect the system is not reliable, they will lose confidence in it" (p. 328). Thus, using inadequate ASR software can "lead to frustrating and counter-productive experiences if learners waste time trying to match a model when their pronunciation is already acceptable" (p. 327). In sum, ASR software has still not reached the point where it provides reliable feedback to L2 learners. On the bright side, in recent years, the speech-to-text application programming interfaces (APIs) —such as *IBM Watson, Google Voice*, and *CMU Sphinx*—underlying commercial voice-recognition software and AI interfaces—such as *Siri, Alexa, Google Home,* and *Amazon Echo*—have become increasingly powerful and accurate. Consequently, the accuracy of ASR dictation systems has increased for both native and non-native speakers (McCrocklin, Humaidan, & Edalatishams, 2018). In the future, the evaluation validity and reliability of ASR in pronunciation apps built with these improved APIs will surely do likewise.

For all these pedagogical and technological reasons, L2 teachers and learners must exercise caution when selecting CAPT software, and they must consider a variety of criteria. Some programs may have initial appeal because of an attractive feature but be lacking in other, important ways. For instance, some L2 pronunciation websites and apps may provide articulatory explanations but no practice. Others might require an accompanying teacher or textbook since they provide practice but minimal explanation or guidance for learners.

Many other differences exist among online resources for L2 pronunciation teaching and learning. For instance, some are free, while others require users to pay a fee. Some focus on segmentals, others on suprasegmentals, and some provide instruction and practice with both. In their user interface, some sites or apps provide helpful graphics, some contain only text, and a few provide video clips that help learners both see and hear how to pronounce English sounds correctly. Some programs follow a flexible, individualized approach, while others expect every user to follow the same curricular path. In sum, the number of criteria to consider when evaluating or selecting CAPT software is considerable, and potential users who focus on some features or criteria while overlooking others do so at their peril. Choosing faulty or inadequate software can lead to frustration and diminished learning experiences.

The analytical instrument described in the next section of this paper is intended to help language teachers and learners avoid such problems by providing a comprehensive set of criteria for analyzing CAPT software, websites, and mobile apps.

## THE ANALYTICAL INSTRUMENT FOR EVALUATING CAPT SOFTWARE

Derwing and Munro (2015, p. 124) urge teachers evaluating, selecting, or recommending CAPT software to "read reviews and recommendations from authoritative sources and then to screen apps carefully before recommending them to students." The instrument described here can be used for conducting such screening. It includes information that will guide teachers and learners of L2

pronunciation in selecting the most appropriate and helpful CAPT resources for their learning/teaching needs. (It might even motivate CAPT software producers to create better products.) It provides a two-page listing of characteristics that potential users of CAPT software, websites, or mobile apps should look for and evaluate before deciding on a particular instructional product.

This instrument has been developed over many years. It began with Persichitte's (1995) "Basic Criteria for Selecting and Evaluating Instructional Software" and was later expanded with elements from Epstein and Ormiston's "Criteria for Developing and Evaluating Materials" (2007, pp. 9-10). Over time, pronunciation-specific criteria advocated by experts (Derwing & Rossiter, 2002; Martins, Levis, & Borges, 2016; Morley, 1991; Munro & Derwing, 2006; Neri, Cucchiarini, Strik, & Boves, 2002; Rosell-Aguilar, 2017) were added. The result was a two-page listing of characteristics or criteria that potential CAPT users should consider when evaluating a particular software product for pronunciation teaching or learning.

For many years, I have used the different, pilot versions of this instrument to evaluate language-teaching software. In the last few years, after refining and focusing the instrument, my graduate students and I have successfully used these criteria for evaluating CAPT software (Henrichsen, 2019; Henrichsen et al., 2018).

Figure 1 shows the front of the two-page evaluative instrument, and Figure 2 shows the reverse side.

**Criteria for Analyzing and Evaluating Computer-Assisted Second-Language
Pronunciation-Teaching and Learning Software, Websites, and Mobile Apps**
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**A. General descriptive information**
1. Name of evaluator: _____          2. Date of evaluation: _____
3. Software title: _____
4. Copyright (or last update) date of software: _____
5. Author, sponsor, or publisher's name (and qualifications): _____
6. Platform: ❏ iOS, ❏ Android, ❏ Macintosh, ❏ Windows, ❏ Linux, ❏ other _____
7. Target language(s): _____ (If English: ❏ British, ❏ North American, ❏ other _____)
8. Language(s) in which instructions are provided: _____
9. Cost: $_____, ❏ free, ❏ ads, ❏ subscription, ❏ other _____
10 Target audience age(s): ❏ children, ❏ teenagers, ❏ adults, ❏ other_____
11. Target audience language level(s): ❏ novice, ❏ intermediate, ❏ advanced, ❏ other _____

**B. Instructional purpose(s) and activities**
1. Primary objectives specified by program (e.g., focuses on developing intelligible [not native-
   speaker] pronunciation):_____
2. Other (secondary, peripheral) objectives: _____
3. Aspects of pronunciation addressed (check all that apply):
   Listening perception: ❏ segmentals, ❏ suprasegmentals, other _____
   Segmentals: ❏ vowels, ❏ consonants, ❏ consonant clusters, other _____
   Suprasegmentals: ❏ intonation, ❏ word stress, ❏ sentence stress, ❏ rhythm, ❏ pausing/juncture,
      ❏ blending, ❏ reduction, ❏ other _____
   Fluency: ❏ pausing appropriately, ❏ delivery speed, ❏ other _____
4. Type(s) of learning activities provided (check all that apply):
   ❏ Analysis or diagnosis of learner's difficulties
   ❏ Listening perception or discrimination
   ❏ Listen to a model and imitate/repeat
   ❏ Listen, record, replay, listen, and compare to model
   ❏ Minimal pairs
   ❏ Variable input (using speech models of different genders, regional dialects, registers, etc.)
   ❏ Contrasts between the learners' L1 sounds and corresponding L2 sounds
   ❏ Loaded sentences or "tongue twisters"
   ❏ Phonetic alphabet symbols and/or charts
   ❏ Articulatory explanations (text or video)
   ❏ Articulatory displays (sagittal section diagrams)
   ❏ Animated "mouth movement" models (video)
   ❏ Visual pitch-contour displays
   ❏ Spectrograms, waveforms, or formant data (of model and/or learner's pronunciation)
   ❏ Flash cards
   ❏ Instructional game
   ❏ Pair-work or group-collaboration activities
   ❏ Automatic speech recognition (ASR) How accurate is the ASR? How often (___%) does it reject
      correct/acceptable pronunciation as incorrect? How often (___%) does it accept incorrect
      pronunciation as correct? How does it do with different dialects?
5. Feedback and record keeping:
   ❏ Provides users with immediate feedback on the correctness of their responses
   ❏ Provides pronunciation feedback that is easily understandable by L2 learners
   ❏ Provides users with helpful, comprehensible guidance on how to correct their mistakes
   ❏ Tracks the number of right and wrong responses for an individual user
   ❏ Keeps track of various individuals in one class and reports scores to a teacher

*Figure 1.* First page of system for analyzing and evaluating CAPT software.

Rate each of the items in sections C, D, and E according to the following scale:

| -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|
| strongly disagree | disagree | no opinion | agree | strongly agree |

NA=Does not apply      CT=Cannot tell (insufficient data)
*Write comments anywhere they fit or on a separate sheet (please refer to item numbers).*

**C. Functionality and usability**

1. Runs properly (i.e., no bugs, crashes, long delays, etc.) ................................. ........     -2  -1   0   1   2   NA  CT
2. Guides the user well (i.e., intuitive interface, provides clear directions for starting,
   navigating, and stopping) ................................ ................................ .................     -2  -1   0   1   2   NA  CT
3. Uses consistent commands and directions throughout ..............................     -2  -1   0   1   2   NA  CT
4. Provides operational "Help" for users ........................................................     -2  -1   0   1   2   NA  CT
5. Allows users to provide feedback or ask questions to the creators............     -2  -1   0   1   2   NA  CT

**D. Instructional factors**

1. Presents information well (i.e., clearly, concisely, interestingly etc.) ....................     -2  -1   0   1   2   NA  CT
2. Provides adequate, thorough, and effective practice ............................... ..     -2  -1   0   1   2   NA  CT
3. Provides helpful feedback................................ ................................ ..........     -2  -1   0   1   2   NA  CT
4. Focuses on priority aspects of pronunciation (e.g., functional load) .............     -2  -1   0   1   2   NA  CT
5. Content is authentic, up to date, and accurate....................................... .....     -2  -1   0   1   2   NA  CT
6. Presents speech in contexts (not just unrelated, individual words)..................     -2  -1   0   1   2   NA  CT
7. Provides various speech models (i.e., multiple speakers' voices) .......................     -2  -1   0   1   2   NA  CT
8. Delivers instruction at a level appropriate for the target audience .............     -2  -1   0   1   2   NA  CT
9. Maintains a constant (or gradually increasing) level of difficulty..............     -2  -1   0   1   2   NA  CT
10. Presents teaching/learning activities in a good sequence .........................     -2  -1   0   1   2   NA  CT
11. Provides helpful interaction with the user(s) ........................................     -2  -1   0   1   2   NA  CT
12. Allows for learner autonomy and independence ....................................     -2  -1   0   1   2   NA  CT
13. Allows users to repeat activities they have difficulty with.......................     -2  -1   0   1   2   NA  CT
14. Allows individualization (learners choose which pronunciation features to work on)     -2  -1   0   1   2   NA  CT
15. Provides meaningful practice (using words learners know) ..............................     -2  -1   0   1   2   NA  CT
16. Provides communicative practice (bridging an information gap) .....................     -2  -1   0   1   2   NA  CT
17. Provides variety in practice activities ................................ .....................     -2  -1   0   1   2   NA  CT
18. Promotes metacognitive activity regarding pronunciation .......................     -2  -1   0   1   2   NA  CT
19. Encourages learners to take responsibility for their improvement ..........     -2  -1   0   1   2   NA  CT
20. Encourages learner strategy development ................................ ..............     -2  -1   0   1   2   NA  CT
21. Supports a variety of learning styles (e.g., visual, auditory, etc.).............     -2  -1   0   1   2   NA  CT

**E. Presentation (User interface)**

1. Uses appropriate, readable text (size, style, variety, and continuity)....................     -2  -1   0   1   2   NA  CT
2. Avoids distracting elements (unnecessary sounds, animations, ads)....................     -2  -1   0   1   2   NA  CT
3. Is not too busy or confusing (e.g., employs "white space" appropriately) ..............     -2  -1   0   1   2   NA  CT
4. Utilizes an attractive, appropriate color scheme.....................................     -2  -1   0   1   2   NA  CT
5. Is aesthetically pleasing in general and looks professional ........................     -2  -1   0   1   2   NA  CT
6. Audio clarity level is high................................ .......................................     -2  -1   0   1   2   NA  CT
7. Audio volume is adequate and adjustable................................................     -2  -1   0   1   2   NA  CT
8. Audio can be played at different speeds (fast, slow)................................ ....     -2  -1   0   1   2   NA  CT

**F. Summary**
1.   Strong points?
2.   Weak points?
3.   Other comments?

*Figure 2.* Second page of system for analyzing and evaluating CAPT software.

Page one consists of "fill in the blank" or "check" items focusing on (A) general descriptive information and (B) instructional purposes and activities. For example, the final item under item B-4 asks specific questions about automatic speech recognition (ASR), such as "How often (___%) does it reject correct/acceptable pronunciation as incorrect?"

On the second page, descriptive statements regarding (C) functionality and usability, (D) instructional factors, and (E) presentation are evaluated using a five-point scale with additional *Does not apply* and *Cannot tell* options. For instance, item D-7 "Provides various speech models [i.e., multiple speakers' voices]" refers to the benefits of high variability phonetic training (Bradlow, 2018; Wang & Munro, 2004). The wide-open items in the "Summary" section give evaluators total freedom in describing anything they see as the overall strengths and weaknesses of the software.

**CONCLUSION**

My TESOL MA students and I have found the guidance this instrument provides to be very beneficial as it focuses our attention on the many characteristics that need to be considered when evaluating CAPT products. By drawing our attention to factors that we might otherwise overlook, it results in a more thorough and professional analysis of the CAPT software under examination. I offer it here for the same reasons. I hope you, your students, and your colleagues will find it helpful when you need to evaluate CAPT websites or mobile apps.

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