Computer-Assisted Language Learning Tools for Punctuation in Dyslexia: Development and Evaluation

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Abstract

The purpose of this paper is to discuss tools relevant to dyslexic students and language teachers with a focus on punctuation. First, the paper briefly discusses existing software in dyslexia. Following this short summary, the paper exemplifies the steps in Computer-Assisted Language Learning (CALL) development by presenting *PunkBuddy*, an original tool aiming at assisting students in post-primary education in Ireland with the use of punctuation. The tool development draws on Second Language Acquisition (SLA) theories and various available technologies, including Text-to-Speech (TTS) technologies, Natural Language Processing (NLP), and dialogue systems in the form of a chatbot. On the basis on this tool, the paper provides a set of desiderata for teachers and developers focusing on dyslexia and proposes a combination of relevant evaluation frameworks.

Computer-Assisted Language Learning Tools for Punctuation in Dyslexia: Development and Evaluation

Considering the widely documented issues of dyslexic students with the use of punctuation, this paper presents the development of a Computer-Assisted Language Learning (CALL) tool that assists dyslexic learners in improving their punctuation skills. The tool, called *PunkBuddy* consists of a TTS interface used to assist the proof-listening of punctuation, a punctuation correction interface which provides suggestions for improvement, and a chatbot aiming at helping dyslexic students understand the use of punctuation through interactions. The development of this tool was conducted during postgraduate studies at Trinity College Dublin for the MPhil in Applied Linguistics (Triantafyllidou, 2020). It is therefore particularly relevant to the Irish educational context, but the potential of using assistive technologies for punctuation training extends to the field of teaching English as a foreign language. This paper explains the theoretical background and rationale for the creation of *PunkBuddy*, as well as the technical aspects of the development and the evaluation of the tool on the basis of the TATL (**T**heory, **A**ctions, **T**echnology, **L**earner,) framework, as proposed by Ní Chiaráin and Ní Chasaide (2015). The paper is relevant to language teachers, as it provides a summary of recent dyslexia tools, as well as to CALL developers and special education teachers focusing on dyslexia.

Software for Dyslexia

An abundance of games and software has been created to assist dyslexic children in interactions (Vasalou et al., 2017), visual training (Ostiz-Blanco et al., 2018), phonemic and phonological awareness (Daud & Abas, 2013; Serrano et al., 2016), ultimately helping dyslexic students in improving their reading and writing. Moreover, assistive technologies for dyslexia include reading and writing assistants, which aim at providing readable interfaces, correcting spelling and punctuation mistakes, and explicitly explaining language use. This section provides a brief overview of recent dyslexia-specific software which provide the background for the creation of *PunkBuddy*.

Recent developments in software for dyslexia include writing assistants such as *GhotIt* and *Ginger*, reading assistants such as *Dyslex.ie*, as well as games and apps. For instance, *Dyslexia.ai* is an app providing a combination of gamified learning, progress tracking for a customised learning experience, and augmented reality (AR). Another example of gamified software for dyslexia is *Dytective*, which incorporates a screening tool along with games and exercises for the treatment of dyslexia (Rello et al., 2016; Rello et al., 2017). Finally, there is an increase in research-led software, as seen for instance in *Dyslex.ie*. *Dyslex.ie* is a browser extension functioning as a reading assistant and it has been developed by a team of students at Dublin City University (DCU) who collaborated with DCU Professor, Dr Ellen Reynor and the CEO of Dyslexia Association Ireland, Dr Rosie Bissett. Another such example of research-led software is *ALEXZA*, created at the Sri Lanka Institute of Information Technology and presented by Rajapakse et al. (2018). The researchers present their work in a comprehensive paper, which outlines the characteristics of dyslexic learners and the underlying causes of dyslexia and includes a review of similar applications. Their paper also discusses the potential of gamification for educational technologies and explains the affordances of technologies using Artificial Intelligence (AI) and Machine Learning (ML) concepts, such as in the development of a chatbot included in ALEXZA. Moreover, their app is informed by feedback provided by dyslexic participants, especially regarding the voice characteristics of the TTS, among other features (2018, p. 5).

Overall, recent software for dyslexia prioritises customisability and opportunities for scaffolded training. For instance, *Dyslex.ie* is fully customisable; it provides a questionnaire and then tailors its settings based on the responses. The questions address aspects of interface design such as spacing, background colours, and fonts. However, there are also examples of software that includes options that are not meaningful or appropriate for dyslexic learners. For instance, *Ghotit* is a software that allows customisation, provides feedback and explanations, and includes some accessibility features, such as reading aloud. It could, however, provide easier-to-use settings for a more readable environment. For instance, users can edit background colours, but, especially for children, these background colours could be limited to those suitable for dyslexia, such as those mentioned in Rello & Bigham (2017). Similarly, the fonts available could also be limited to dyslexia-friendly fonts. Adding distractions and more features than needed does not serve this specific learner group and its needs. For young students, these features might also interfere with the studying process, i.e. a student might end up experimenting with fonts instead of focusing on writing. Regarding scaffolding, *Dyslexia.ai* offers training on all skills (reading, writing, listening, speaking) with activities which track progress and provide increasing difficulty. Moreover, the app uses phonics, which have been found to be effective in dyslexia trainings and treatments (Galuschka et

al., 2014; Schaars et al., 2017). Specifically, van Rijthoven et al. (2020) have found that the individual variations of dyslexic students in phonological awareness, word processing, and verbal working memory do not significantly affect the effectiveness of phonics as a treatment. Therefore, recent apps rely on validated methods for training while experimenting with new technologies.

For more extensive reviews on dyslexia software, see also Triantafyllidou (2020, pp. 41-58), Rakopoulou (2020) Indal & Mavéus (2019), Satapathy (2019), Ili Farhana (2018), Madden (2012), and Draffan (2002). To summarise, the main characteristics of current software for dyslexia are:

1. Assistive Technology Support: Dyslexia software includes accessibility options, such as reading aloud via TTS and customising or chunking text via OCR.
2. Customisability: Most software offers customisability options, providing dyslexic students with a tailored experience. However, sometimes there are more options than needed, as seen in *Ghotit.*
3. AI-Informed Methods: AI is becoming part of recent software for dyslexia with chatbots and progress tracking.
4. Paywalls: Most software either requires a subscription or offers free trials, thus requiring payment in the long run.
5. Autonomous Learning: Most software currently available is suitable for individual study, rather than use in the classroom or for pair- and group-work.

The Development of *PunkBuddy*

The dyslexia software mentioned above and their characteristics have been taken into consideration for the development of *PunkBuddy*. To recap the functionalities of *PunkBuddy*, it consists of two main components:

1. A TTS component; this offers dyslexic learners the chance to proof-listen their text and correct it on their own based on what they hear before moving on to step 2.
2. A punctuation correction interface; this offers dyslexic learners suggestions on improving their punctuation and advises them on sentence length.

Finally, *PunkBuddy* includes a chatbot aiming at helping dyslexic students learn through interaction. However, the chatbot remains at a very early stage of development and currently exists as an additional component to the main CALL tool. Currently, it can advise students on the rules of using punctuation, utilising the benefits of explicit instruction. At a later stage, it would be able to provide further examples and better tailored assistance, for instance help with a particular context of punctuation in which a student struggles.

The section begins by outlining the TATL framework for CALL development (Ní Chiaráin & Ní Chasaide, 2015) and the needs of the learner group addressed by the tool, i.e. post-primary school students in Irish education. However, as mentioned in the introduction, *PunkBuddy* can be extended in English as a Foreign Language contexts. Following the learner group, the section outlines theories of language acquisition which inform the development of the tool. Finally, the actions prompted by the tool and the technologies used for its development are outlined before moving on to its

evaluation.

The TATL Framework and the Learner Group

The TATL (**T**heory, **A**ctions, **T**echnology, **L**earner) framework suggests that CALL development should take into account theories of language acquisition and involve actions stemming from these theories, while considering the affordances and limitations of technologies, as well the individual needs of the learners. It places emphasis on meaningful design regarding the tasks and the interface of CALL tools, avoiding features that do not improve the effectiveness of tools in language learning. The framework bridges theories of language acquisition, pedagogy, and language technologies, aiming at providing a reliable guide for CALL development. Finally, the evaluation is fed into the improvement of the tools, following a cyclical development process.

The learner needs that are taken into consideration for the development of *PunkBuddy* include educational needs, cognitive needs in relation to dyslexia, and the emotional needs of dyslexic pre-adolescents. To recap, *PunkBuddy* addresses students in ages 12 and above who are enrolled in mainstream Irish education and are in the transition from primary to post-primary education.

The transition from primary to secondary education is especially important due to the changes in written assessment. According to the official Junior Cycle curriculum, writing has a prominent place in assessment, both in the form of classroom-based assessment, as well as in final assessment tasks (N.C.C.A, 2019; N.C.C.A, 2020). However, writing in Primary School is mostly in the form of free writing, without any explicit instruction on composition writing (N.C.C.A, n.d). Dyslexic learners might encounter issues during this transition phase, considering their difficulties with writing.

Some books in the Junior Cycle include explicit instruction on punctuation, as seen for instance in *Kingdom 1* (Allsopp et al., 2018) and *Great Expectations 1* (Leddin, 2014), and the use of *PunkBuddy* aims at enhancing this instruction. Meanwhile, it allows students to work autonomously in the classroom as well as on their own, which assists both teachers who might not be able to help each student individually, as well as students themselves who are able to work independently with the assistance provided by the tool.

Regarding cognitive needs, it is important to take into account the deficits observed in dyslexia. Dyslexic learners have been found to have deficits in phonological awareness, which is reflected in their writing. According to the Phonological Deficit Hypothesis, phonological processing is impaired in dyslexia, thus impacting both reading and writing (Snowling, 1998; Rack, 2018). Meanwhile, issues with reading render proof-reading ineffective, as students fail to detect their errors. This is especially the case with punctuation, which is often misused or absent in dyslexic texts (Feka, 2016, pp. 16-17; Mortimore & Crozier, 2006; Tops et al., 2013). Therefore, dyslexic learners need a tool that facilitates the proof-reading process and helps them add punctuation accordingly.

Moreover, considering that punctuation is a form of written prosody, often correlated with prosody in speech, it is important to consider prosodic processing in dyslexia. While implicit prosody and silent reading are under-researched in dyslexia, there is evidence that dyslexic children show impairments in prosodic processing dyslexia (Goswami et al., 2010; Goswami et al., 2013; Goswami, 2019). Sabisch et al. (2006) show that prosodic information is accessed during auditory comprehension, but their ERPs study shows that dyslexic children do not rely on that prosodic information to decode meaning. Agreeing with these findings, Honbolygó et al. (2016) also show the importance of prosody for the construction on meaning and the interfaces between prosody and syntax. Similarly, Marshall et al. (2009) report impairments where syntax interacts with prosody, for instance in chunking (p. 480), but observe no or little evidence of prosodic impairments in the cases where prosody does not interact with linguistic meaning. Finally, one recent study focuses specifically on the interfaces between prosody and punctuation. Heggie and Wade-Wolley (2018) present evidence that prosodic awareness is a strong predictor of punctuation ability in adults and that punctuation and prosody facilitate reading comprehension. Specifically, they studied receptive and productive prosodic awareness and productive punctuation ability in literate, educated adults and found statistically significant correlations between prosodic awareness and punctuation skills.

Therefore, it is important to assess whether using TTS technologies is appropriate for dyslexia, and especially as a method of proof-listening, which is at the core of the rationale for the development of *PunkBuddy*. Giannouli and Banou (2019) investigated the intelligibility of synthetic speech in primary and post-primary dyslexic students in Greece and found that words and sentences were statistically significantly easier to parse in natural speech. However, whole texts in synthetic speech were intelligible due to contextual clues and the difficulties encountered with words and sentences were absent in the text comprehension condition. One issue in this study is that, while the TTS system the researchers used was advanced enough to replicate prosody to a high degree, they did not implement the use of TTS in the classroom, which has showed to improve ratings of intelligibility for speech synthesisers (Ní Chiaráin & Ní Chasaide, 2017). Moreover, Greek and English are widely different in phonological nature and, therefore, testing *PunkBuddy* in the future would allow a more comprehensive view on synthetic speech intelligibility for dyslexic students.

Finally, apart from the educational requirements of the curriculum and the characteristics of dyslexic learners, it is important to consider emotional factors. Studies on dyslexic adolescents have shown high skill-specific anxiety levels (Piechurska-Kuciel, 2010). Moreover, Eissa (2010) reports issues at socialisation and lower self-esteem, as well as higher scores in depression, aggression, and social problems in dyslexic adolescents (p. 23). Taking the above into account, the tool aims at minimizing anxieties by assisting students in improving the quality of the texts and providing them with a safe space for interactions. To elaborate, while interaction and collaborative writing have generally yielded positive results (Lee et al., 2016), peer-interaction might not be as useful in this case. Instead, autonomous use of a punctuation correction interface and Human-Computer Interaction (HCI) in the form of a chatbot are ways to avoid personal interactions which might generate stress, while providing students with a chance to improve their writing skills.

Theories of Language Learning

PunkBuddy relies on three theories: Schmidt's (1990) Noticing Hypothesis, VanPatten's (2004) Input Processing Theory, and Vygotsky's (1986) Sociocultural Theory. Schmidt's (1990) Noticing Hypothesis supports that the first step towards learning is noticing of forms and it is widely cited in CALL research (De La Fuente, 2014; Radwan, 2005; Rassaei, 2020). Schmidt (1990) explains that awareness is an essential for step for input to be transformed into uptake, which is acquired knowledge. He also adds an intermediary step between input and uptake, called intake; noticing ensures that input is first converted into intake in order to be acquired. Text Enhancement (TE) and proof-listening through the TTS are used in *PunkBuddy*, prompting learners to notice lack or misuse of punctuation in their writing.

VanPatten's (2004) Input Processing Theory supports that emphasis on meaning is essential for input to be transferred from working memory to long-term memory. His theory suggests that meaning is processed before form, which is particularly relevant for punctuation teaching. Even though several guides provide specific instructions on how punctuation is to be used, its real-life implementation varies. Therefore, teachers first need to explain the meaning behind pauses, while students themselves are to experience how the lack of these pauses impacts their text by proof-listening their text through the TTS. In *PunkBuddy*, the rules of punctuation are explained through the chatbot. Additionally, one of the main principles of the Input Processing Theory is the "Availability of Resources Principle" (VanPatten, 2004, p. 14), according to which the input should be tailored in such a way that does not drain the student's attentional resources. This is especially relevant to the design of dyslexia software interface. Generally, overloading the students with input beyond their attentional resources disrupts language acquisition. Moreover, customisability in CALL tools for dyslexia would ensure that students receive as much input as they can handle, for instance punctuation corrections based on their skills.

Finally, Vygotsky's (1986) Sociocultural Theory, claims that learning is achieved through scaffolded interaction. Scaffolding is relevant to CALL design and evaluation as seen in the previous section. Additionally, learning through interaction is relevant to the chatbot created for *PunkBuddy*, even though its interactive capabilities are still limited. Other modes of peer-interaction are also popular with CALL, but for this specific learner group I am considering the emotional needs mentioned in the previous section. Therefore, choosing a mode of interaction that minimises anxieties while providing individualised assistance allows learning through interaction. For the benefits of using chatbots in language learning, see also Arispe (2014).

Actions and Technology

First, *PunkBuddy* prompts users to listen to their composition and add punctuation as needed. Users proof-listen their text at least three times before moving on to the punctuation correction interface. This interface provides hints for the improvement of punctuation and informs users on their sentence length. Meanwhile, the chatbot remains available for assistance at all times, providing explicit instruction on the meaning of punctuation marks. The actions prompted by *PunkBuddy* are summarised in the graph below.

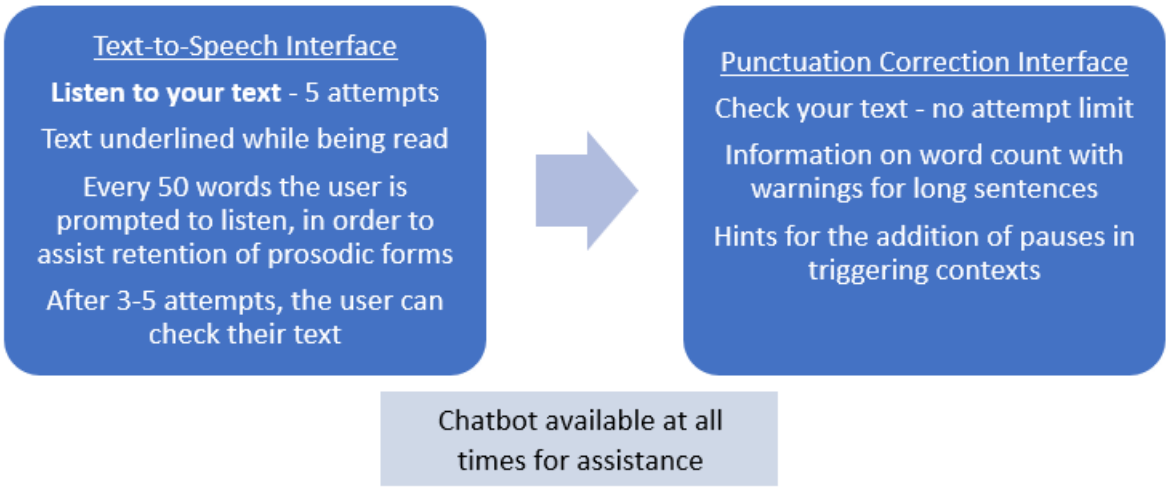

Figure 1. The Actions Prompted by PunkBuddy.

PunkBuddy is deployed on a *Vercel* website built with *React* and *Typescript* and it has been set up by Luke Lau, MSc Computer Science graduate from Trinity College Dublin. It is accessible through the *PunkBuddy* website (https://PunkBuddy.vercel.app/), while the steps of its development are visible through its public GitHub Repository (https://github.com/triantac/PunkBuddy). *PunkBuddy* uses the open-source MIT License, making its code available to all parties interested.

The Text-to-Speech Interface

When entering the website, the user is prompted to write their text and listen to it. Instructions are visible only when hovering over them in order to minimise the clutter of text on the screen. The user can choose between three fonts and between three background colours, all of which have been chosen based on the findings of Rello and Baeza-Yates (2016) and Rello and Bigham (2017). Their findings suggested that Arial, Open Dyslexic, and Courier are among the most readable fonts and that yellow, peach, and orange provided the most readable backgrounds.

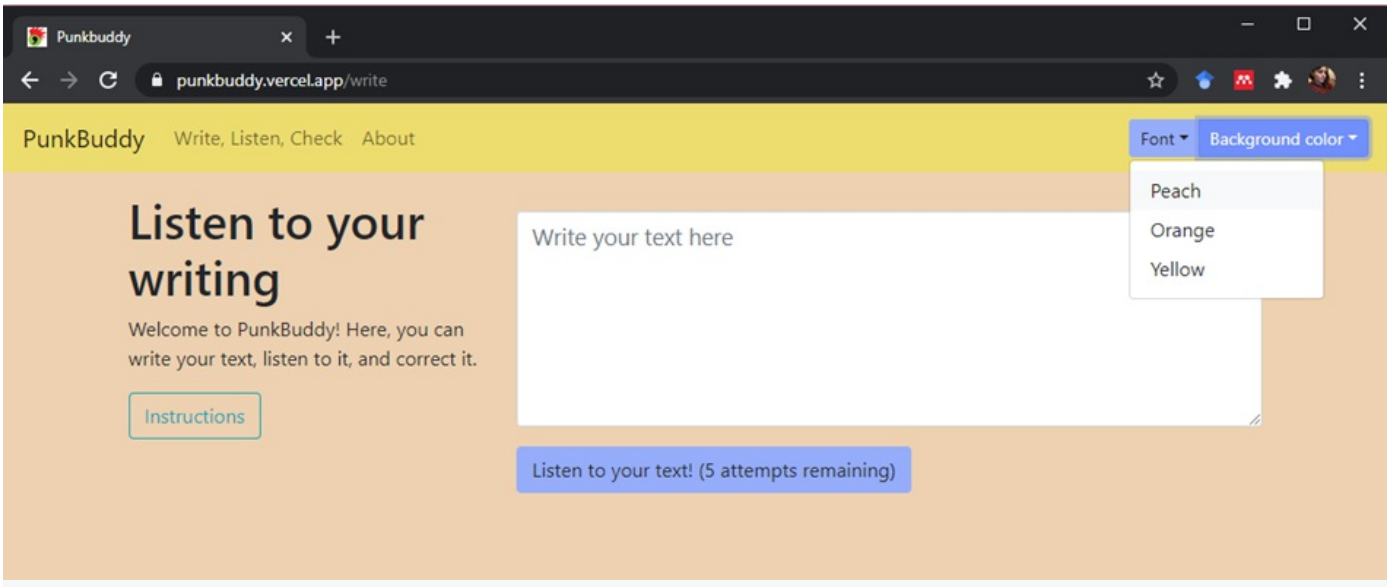

Figure 2. Customisability Offered by PunkBuddy.

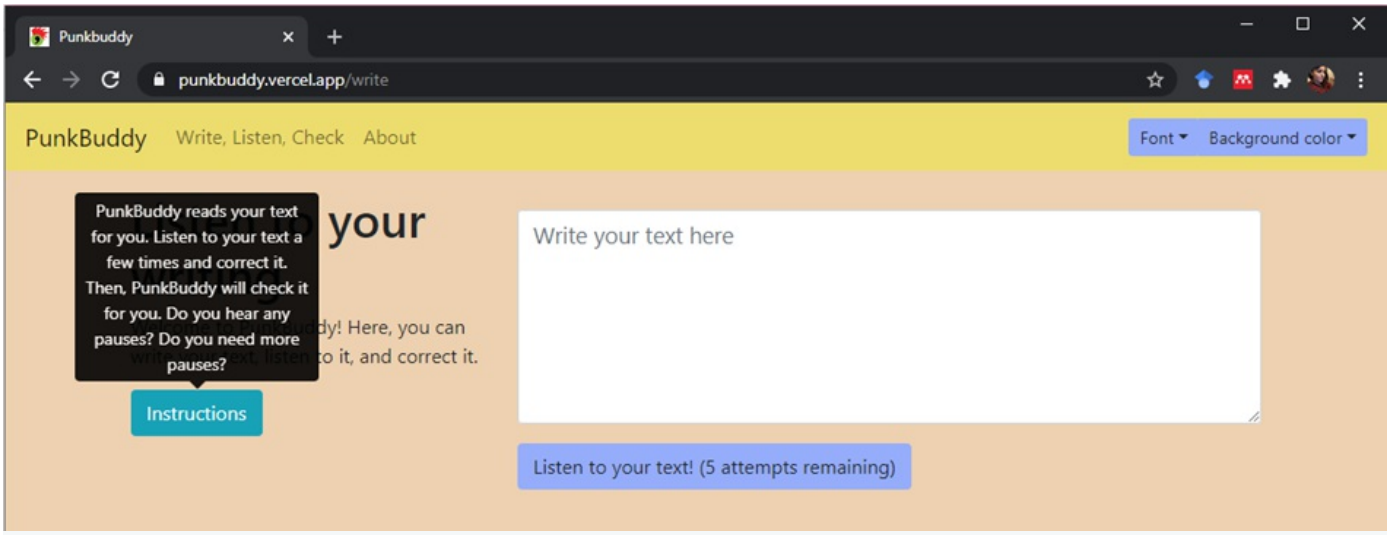

Figure 3. Instructions Offered by PunkBuddy.

The TTS interface offers a minimum of three attempts and a maximum of five attempts. The number of attempts left is visible at all times. The user can also pause the text as it is being read and then continue listening again. To enhance noticing and readability, the text is underlined as it is being read. Moreover, the user is prompted to listen to their text every 50 words, in order to minimise short term memory effects (Goswami et al., 2016). The TTS is powered using the *JavaScript Web Speech API*; if not available, the *Google Cloud Speech Synthesiser* is used as back-up. The initial plan was to use the *Google Cloud Speech Synthesiser* only, which uses neural networks to synthesise speech and is therefore more natural, but most neural network speech synthesisers did not allow customisations, such as underlining text as it is being read to enhance readability.

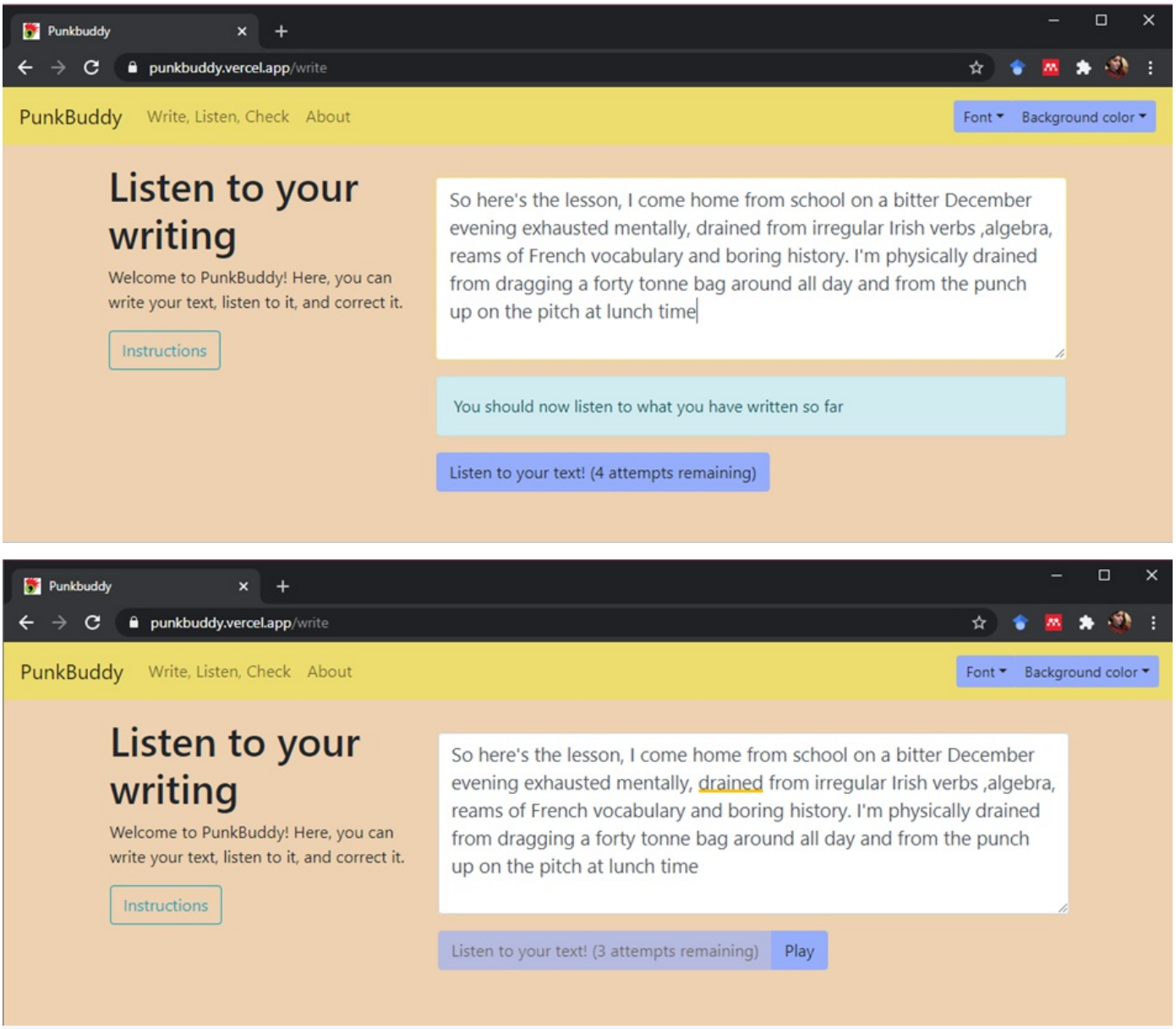

Figure 4. The PunkBuddy TTS.

The Punctuation Correction Interface

The punctuation correction interface takes into account the variation in the individual use of punctuation (Søgaard et al., 2018). It has been designed on the basis of a corpus analysis using English textbooks and a Punctuation Perception Test, both of which are outlined in Triantafyllidou (2020, pp. 15-29). Based on these findings, the punctuation correction interface suggests the addition of a comma in these cases:

1. Before trigger words: but, as, so, though,
2. Before and after adverbials and phrases: instead, however, firstly, secondly, finally, ultimately, alternatively, eventually, in my opinion, in conclusion
3. After adjectives
4. After salutations.

5.

Regarding full stops and sentence segmentation, the word count bar shows the length of each sentence in the form of a progress bar, giving a yellow warning at 15 words and a red warning at 18 words. The comma suggestions are generated by a combination of simple string searching and *Google Cloud's Natural Language API*. The *Natural Language API* was especially used to detect adjectives and salutations. The coding behind *PunkBuddy's* punctuation correction is available on GitHub (*PunkBuddy* Repository, 2020).

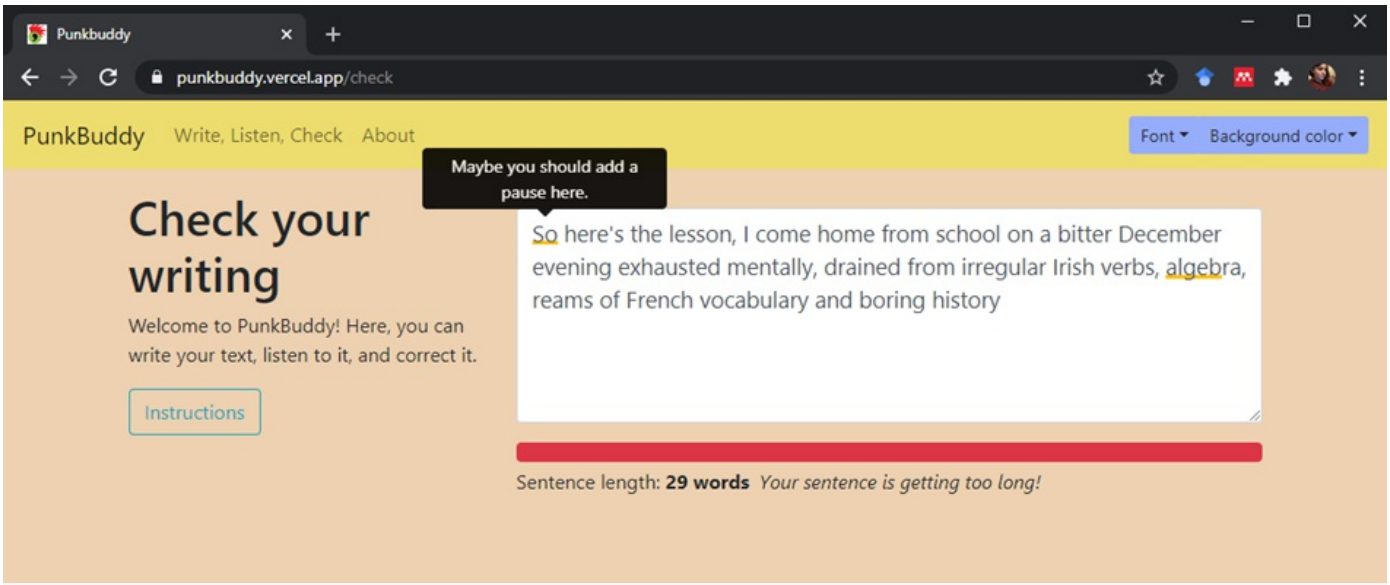

Figure 5. Sentence Length and Punctuation Suggestion in PunkBuddy.

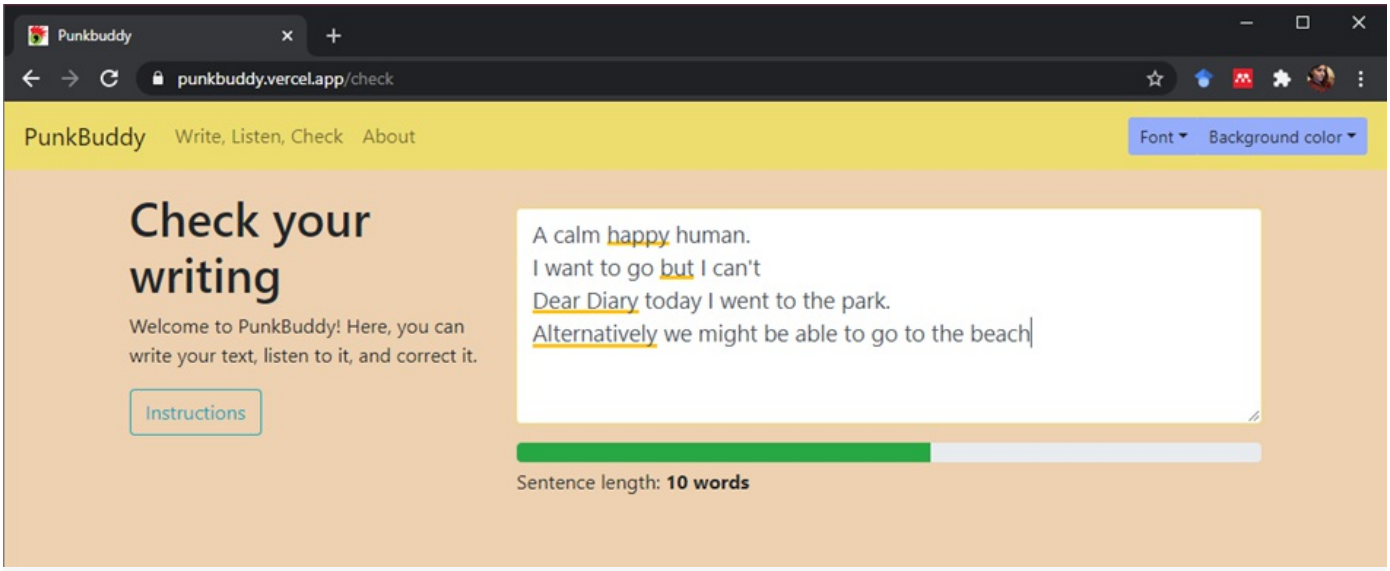

Figure 6. Comma Suggestions in PunkBuddy.

The Chatbot

The *PunkBuddy* chatbot is at an early stage of development and it is made and deployed on*Pandorabots* using Artificial Intelligence Markup Language (AIML). Regarding its conversational abilities, it offers short, simple-worded explanations on the meaning of punctuation marks, i.e. full stops, commas, and question marks, and can exchange salutations.

The Evaluation of *PunkBuddy*

For the evaluation of *PunkBuddy*, I propose the combination of two frameworks: Rosell-Aguilar's (2017) "State of the App" taxonomy and Hubbard's (2006) evaluation framework. The "State of the App" addresses all aspects of technological design and sets solid criteria for language learning, taking into account attention, communicative outcomes, engagement, productive skills, and authenticity, among others (Rosell-Aguilar, 2017, p. 252). Meanwhile, Hubbard's (2006) framework considers "teacher fit" in the evaluation process, including aspects of classroom management, syllabus fit, and learner training (Hubbard, 2006, pp. 14-17). To summarise the evaluation, I present the criteria in the form of a concise table adapted from Rosell-Aguilar's (2017, p. 253) framework. His table takes into account all aspects of CALL aspect and is especially learner-oriented, while integrating pedagogy and thus relating to teaching. Nevertheless, the needs of the teacher are not directly addressed within this taxonomy, which is why I have added a section in the table to address those needs based on Hubbard's framework.

Table 1. *Evaluation Framework for Dyslexia Software.*

Language Learning	Pedagogy	Teacher Fit
Listening: Does the software provide audio in the target language? **Writing**: Does the software offer opportunities to write in the target language and exercises for writing practice? **Reading**: Does the software provide a readable environment for dyslexic learners?	**Teaching**: Does the software present, explain, or model language or does it just test it? **Progress**: Does the app allow the user to track progress or see previous attempts? **Scaffolding**: Do activities in the software progress in difficulty in a way that supports the learner? **Feedback**: Does the software provide feedback? Is it just right/wrong or with meaningful explanations? **Differentiation**: Does the software offer different levels depending on ability? Can these be accessed directly? **Engagement**: Does the app keep the user interested or are activities repetitive?	**Approach fit**: Is the software flexible enough to fit within various approaches to language teaching? **Classroom management**: Is the software flexible enough to be used individually, in pairwork, and in group work? **Syllabus fit**: Is the software appropriate for multiple types of syllabi? Is it tied to a specific topic only? **Training**: Will the software require training for the teacher and the learner? Is there a big learning curve?

User Experience	Technology
Interactivity: Is engagement with the software content active or passive? **Customisability**: Does the software offer options based on the user's preference? **Price**: Is there a paywall? **Registration**: Does the software require the user to register? **Advertising**: Does the software include pop-up ads? Are these distracting?	**Interface**: Is the interface clear and uncluttered? **Navigation**: Is the software intuitive to navigate, with clear menus and options? **Instructions**: Does the software offer instructions on how to use it? **Stability**: Does the app freeze or crash? **Portability**: Is the software available on multiple platforms? Does it support offline work?

While these frameworks are essential for future testing with users, i.e. dyslexic students, a current self-evaluation is limited to a set of learner, task, and teacher desiderata presented in Triantafyllidou (2020, pp. 59-60). At its current stage *PunkBuddy* offers limited features and I am summarising the work done and the future development needed in the table below. The table is colour-coded to show the aspects of *PunkBuddy* that have been developed to an adequate degree (green) and those that need more work (red). As it becomes evident, the tool is currently suitable mostly for autonomous use on computers. Moreover, due to the sophisticated level of coding required for AI-informed methods, the tool cannot currently provide scaffolded instruction with increasing difficulty and differentiated feedback.

Learner Desiderata	Task Desiderata	Teacher Desiderata
Customisability: choice of fonts available and background colours available; no choices of voice in the TTS	Authenticity: some real communicative tasks through the chatbot	Portability: only available as a website, requires an Internet connection; not yet responsive on mobile devices
Explicit instruction: text highlighted when read, trigger words for punctuation highlighted	Scaffolding: some scaffolding by progressing from the TTS interface to the punctuation checking interface; no differentiated difficulty	Flexibility: mostly suitable for individual work
Feedback: meaningful feedback through the chatbot; hints rather than corrections Clear interface: hoverable instructions, no added media, few colours and buttons		Ease of use: straightforward instructions and clear interface to facilitate ease of use

Table 2. *Evaluation of PunkBuddy.*

Evaluating *PunkBuddy* would require testing it with dyslexic students and their teachers, in order to determine the aspects needing improvement. Especially regarding the TTS interface, it is important to determine whether the auditory feedback received is intelligible. Testing *PunkBuddy* within the interactive context of a classroom might elicit more favourable reviews (Ní Chiaráin & Ní Chasaide, 2017), but considering that this tool is mostly tailored for autonomous use, it is important to test the TTS in individual student work. For the evaluation of TTS technologies in particular, see also Grimshaw et al. (2018). Finally, an interesting aspect of evaluation would be to consider what Rosell-Aguilar (2017, p. 255) calls “appsmashing”, i.e. the combination of different apps in autonomous use. For instance, it would be interesting to examine whether dyslexic students would combine *PunkBuddy* with other spellcheckers and readability enhancement tools, or with apps and tools beyond the assistive spectrum.

Conclusive Remarks

This paper has outlined the development of a CALL tool for punctuation training in dyslexia. It presents how CALL development unfolds within the TATL framework, taking into account all aspects of language learning in order to create a focused and meaningful tool. Discussing the process of software development is essential in English Language Teaching discourse, as it adds transparency to the methodologies applied in the field of educational technologies. Additionally, discussions on the technical aspects of development are relevant to forthcoming researchers, language technologists, as well as language teachers themselves. Additionally, creating accessible evaluation tools is an essential aspect of CALL, as teachers need to fit these evaluations within the already time-consuming process of teaching. While detailed frameworks are important for researchers and developers, practitioners in teaching should be at the heart of CALL development, as they are one of the main parties interested in such tools.

Regarding *PunkBuddy* in particular, future development should prioritise better punctuation correction. For instance, differentiating between restrictive and non-restrictive relative clauses, determining whether apostrophes are needed in a pronoun, and suggesting commas in tag questions would provide a more accurate punctuation correction interface. Additionally, further development should focus on progress tracking methods and scaffolded tasks. For instance, punctuation corrections can be offered based on the level of the learners and their most frequent errors, while students should also be praised when making improvements. Other aspects to consider include portability, offline use, and further development of the chatbot.

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