Reading on mobile digital screens: does text presentation mode affect comprehension?

Leitura em telas digitais móveis:
o modo de apresentação do texto
pode afetar a compreensão de leitura?

Lectura en pantalla de móvil:
¿la presentación del texto modificado
afecta la comprensión?

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Abstract

As mobile devices become smaller and more appealing among readers, the use of technology to improve reading efficiency in terms of speed and comprehension has recently increased in popularity. An important question to be pursued is whether the way in which texts are presented on screen has any impact on reading comprehension. In the current study, we examined whether there are differences in reading comprehension using Spritz - a digital tool which presents words one at a time on screen, at different speed – as compared to conventional hypertext reading. Fourteen participants (mean age 25.5, 7 male) took part in the experiment by reading two texts using Spritz and two conventional hypertexts. Subjects had three minutes to read each text and five additional minutes to answer seven multiple-choice questions about each text. Results show that the way the stimuli were presented (Spritz or hypertext) did not affect participants' performance in the reading comprehension task.

Keywords: Mobile devices, reading comprehension, spritz.

Resumo

À medida que os dispositivos móveis tornam-se menores e mais atraentes para os leitores, o uso da tecnologia para melhorar a eficiência de leitura em termos de velocidade e compreensão aumenta em popularidade. Uma questão importante a ser abordada é se a maneira como os textos são apresentados na tela móvel tem qualquer impacto sobre a compreensão da leitura. No presente estudo, examinamos se existem diferenças na compreensão de leitura usando *Spritz* - uma ferramenta digital que apresenta palavras uma de cada vez na tela, em velocidades diferentes - em comparação com a leitura convencional de hipertextos. Catorze participantes (idade média 25.5, 7 homens) participaram do experimento, lendo dois textos usando *Spritz* e dois hipertextos de forma convencional. Os sujeitos tinham três minutos para ler cada texto e cinco minutos adicionais para responder a sete questões de múltipla escolha sobre cada texto. Os resultados mostram que a forma como os textos foram apresentados (*Spritz* ou hipertexto) não afetou o desempenho dos participantes na prova de compreensão de leitura.
**Palavras-chave:** dispositivos móveis, compreensão de leitura, spritz.

Resumen

A medida que los dispositivos móviles se vuelven más pequeños y más atractivos para los lectores, el uso de la tecnología para mejorar la eficiencia de lectura en términos de velocidad y comprensión aumenta en popularidad. Una cuestión importante a tratar es si la forma en que los textos se presentan en la pantalla móvil tiene algún impacto en la comprensión de la lectura. En el presente estudio, examinamos si existen diferencias en la comprensión de lectura usando Spritz - una herramienta digital que presenta palabras una a la vez en la pantalla, a diferentes velocidades - en comparación con la lectura convencional de hipertextos. Catorce participantes (edad media 25.5, 7 hombres) participaron del experimento, leyendo dos textos usando Spritz y dos hipertextos de forma convencional. Los sujetos tenían tres minutos para leer cada texto y cinco minutos adicionales para responder a siete preguntas de elección múltiple sobre cada texto. Los resultados muestran que la forma en que los textos fueron presentados (Spritz o hipertexto) no afectó el desempeño de los participantes en la prueba de comprensión de lectura**.**
Palabras clave: dispositivos móviles, comprensión de lectura, spritz.

Introduction

The use of technology for pedagogical purposes is no longer a new topic in the field of Applied Linguistics. However, studies on technology-enhanced teaching and learning strategies are still relevant due to the constant release of innovative gadgets and apps. Researchers have shed light on the usefulness of technology for the development of skills in language learning as they investigate, for example, the use of web-based technologies, such as GoogleDocs to develop writing skills (LEANDRO, 2014; KESSLER; BIKOWSKI; BOGGS, 2012; RIBEIRO, 2010); VoiceThread to develop speaking skills (WEISSHEIMER; SOUSA, 2014); MMORPG games to develop general language skills (SOARES, 2013); and the use of social networking websites to develop interpersonal skills and promote autonomy (BOSCH, 2009; MAZER; MURPHY; SIMONDS, 2009; WEISSHEIMER; LEANDRO, 2016).

There seems to be an agreement among researchers that technological components lead to better learning results when they are used in a blended manner (BLAKE, 2011; ROSEN, 2009), with the combination of the best aspects of face-to-face and distance learning. Also,
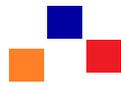
as pointed out by Weissheimer and Leandro (2016), the blended learning format may be very beneficial for the learning process, since it respects the learner's individual pace and motivation to learn, as s/he can study online whenever s/he needs and/or feels like doing so, differently from exclusively traditional, face-to-face teaching/learning environments.

Another interesting point when it comes to the use of technology in learning is that one finds a number of studies which focus on the use of tools/apps/websites that have not been originally designed for pedagogical purposes (LEANDRO, 2015; WEISSHEIMER; LEANDRO, 2016), but that have been somehow adapted to serve the language learning domain. This gives researchers a great number of possibilities to explore in terms of the set of skills one usually struggles to develop in the classroom, as a teacher and as a student, and this includes reading.

The twenty-first century society has got used to reading on digital screens - which does not prove traditional paper-based documents obsolete. However, this raises the important question of what type of text presentation mode is more effective when it comes to reading on digital mobile screens. In the era of small screens, traditional reading (i.e. left-to-right, top-to-bottom) is called into question and rapid serial visual presentation (RSVP) represents one of the main alternatives. RSVP consists of displaying in sequential order one or more words at a time, thus minimizing saccades and eye blinks.

Among a myriad of sophisticated technological advances to reading, recently one RSVP application has received a lot of media attention: it is the case of Spritz. Spritz[1] is an app which claims to develop reading skills by increasing focus and reading pace, as words are shown one by one on screen, and eye movements are reduced by having readers fixate on a pre-located *optimal viewing position* (OVP). Once the Spritz app is downloaded, it allows any web-based content to be read in such manner, at different paces, on any devices.

According to Spritz's developers, the rationale behind Spritz's potentialities is that the elimination of saccades should reduce visual fatigue and improve reading comprehension. One potential and more recent application of Spritz reading has been to use the app to accommodate the needs of people with reading disabilities and attention disorders, such as dyslexia and ADHD, respectively. These people are known to benefit from adapted texts with more space between lines, more breaks and other adaptions whose main goal is to provide a less cluttered reading environment (SHAYWITZ, 2005), and, therefore, they could have a better reading experience with the use of such word-to-word presentation methods.

Because the main goal of the present study is testing Spritz's usefulness as a tool to enhance reading skills, the next sections will be devoted to summarize the main findings concerning eye movements during reading and word recognition and its relation to text comprehension.

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1   Founded in 2012 by Frank Waldman, a serial entrepreneur and MIT alum; Maik Maurer, businessman and scientist focused on innovation, and his colleague Matthias Klein, Spritz's mission is to change the way people read on mobile devices by making communication faster, easier and more effective. This technology has been researched, developed and tested in Boston, Munich, and Salt Lake City. For more information about Spritz, please refer to www.spritzinc.com.
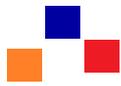
The optimal viewing position in reading

It does not matter if we are reading or recognizing words, our eyes tend to be fixated in certain preferential locations of what they are decoding. According to O'Regan and colleagues (1984), the *convenient viewing position* hypothesis is a phenomenon which shows that when we are reading our eyes tend to focus slightly left of the center of the word, in a way that the group of letters can be projected at the center of the fovea. Fixating other parts of a word might lead to a loss in efficiency.

The traditional reading format comprises the organization of texts in horizontal lines and our inherent tendency to move our eyes from one word to another, sequentially. For each phrase, the organs of vision seek a specific point of this written representation; such location is called *Optimal Recognition Point* or ORP. Subsequently to the location of the ORP, the human brain is put to work on the meaning of the highlighted item. With each new lexical item we have the same chain of events - once found the ORP, there will be the processing of the meaning of both word and context.

One of the reasons why fixation on the first half of the word will improve its subsequent comprehension lies on the fact that most lexical information on a word is situated in its first part (NAZIR, 2000). Therefore, fixating on the OVP of a particular word will allow better use to be made of partial lexical information, and thus improve performance when the eye is fixating where the information is (O'REGAN et al,1984; McCLELLAND; O'REGAN, 1981).

According to Brysbaert and Nazir (2005), this optimal viewing position (OVP) is the result of an interplay of four variables: (1) the distance between the viewing position and the farthest letter, (2) the fact that the word beginning is usually more informative than the word end, (3) the fact that during reading words have been recognized a lot of times after fixation on this letter position, (4) and the fact that stimuli in the right visual field have direct access to the left cerebral hemisphere.

Besides the OVP claim, another pertinent issue when it comes to reading is the alignment of words in a text. Under the traditional reading of words in text, the eyes are moved with a high frequency, which is believed to stretch for too long the required reading time and affect to some degree the understanding of what was read. Another effect of the conventional text presentation mode is that it may impose problems for poor readers, and especially, for people with reading disabilities. Some of the problems these people face while reading include larger effects of crowding and the impact of increased numbers of distractors, all of which have shown to correlate significantly with measures of reading comprehension (MOORES, CASSIM, TALCOTT, 2011).

An alternative text presentation mode, one taken into consideration by the Spritz app, is known as Rapid Serial Visual Presentation (RSVP). RSVP originated as an experimental model frequently used to examine the temporal characteristics of attention. The RSVP paradigm entails participants to look at a continuous presentation of visual items, which are shown one at a time, all in the same place. Besides increasing reading speed, this

presentation paradigm may reduce the attentional load on the reader, avoiding crowding effects and confusion generated by competing distractors in parafoveal vision. Most research under the RSVP paradigm has been conducted with word recognition. This raises the question of to what extent the OVP phenomenon and the RSVP paradigm have implications for text reading as well. This question is pursued in the present study.

Spritz tool immerses in the technological sphere as an alleged reading-comprehension facilitator, while it also reduces the usual time demanded by such activity. One of Spritz' main applicabilities would be, therefore, to increase one's reading speed: instead of showing an entire textual composition or even a full paragraph to be read at once, the device provides one lexical item at a time in the vertical direction. As Figure 1 shows, the technique consists of highlighting the main letter within each word (the red letter, located in the OVP) and thus save time. One's brain is expected to recognize this word faster and Spritz' user does not need to move the reading focus from screen.
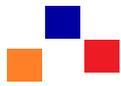
Figure 1 – A comparison between RSVP reading and Spritz reading.

Available at http://spritzinc.com/why-spritz-works-its-all-about-the-alignment-of-words
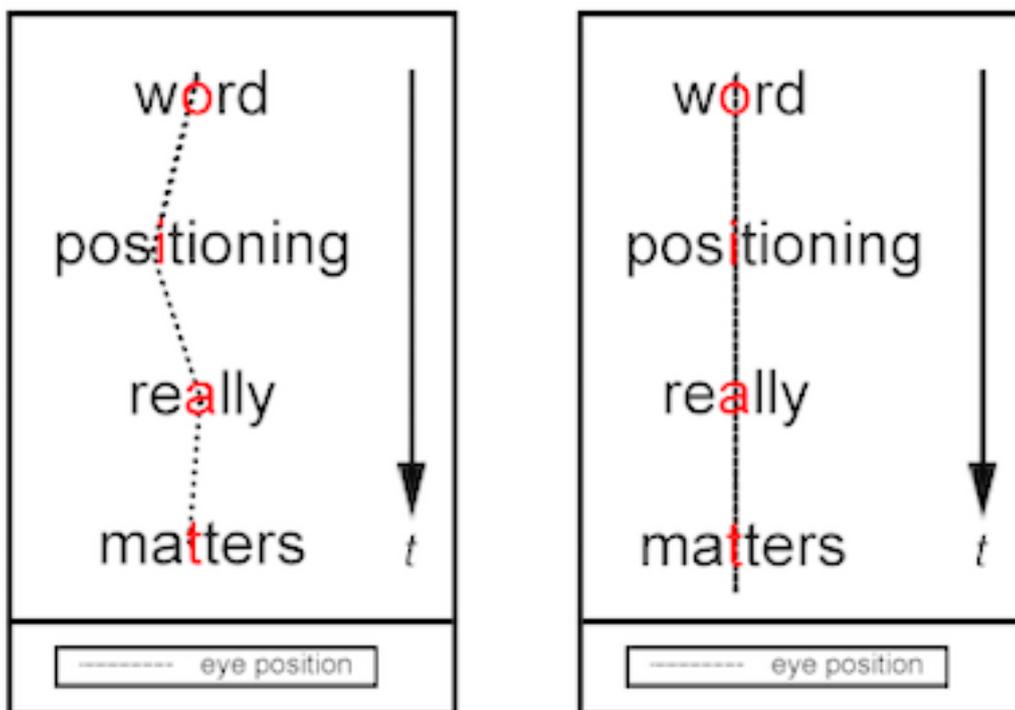
A study conducted by the Penn Schoen Berland research group[2] revealed that Spritz's reading technology produced at least a 20% faster reading experience without sacrificing comprehension amongst first-time Spritz users. This research included 1000 respondents, in two phases, each among 500 general consumers who speak English as their first and

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2   Available at http://www.prnewswire.com/news-releases/penn-schoen-berland-psb-study-finds-spritz-technology-increases-reading-speed-without-sacrificing-comprehension-273092371.html

primary language. Respondents were timed as they read two different reading exercises. Those who were assigned to the control group read the passages traditionally, whereas those who were in the experimental group read the passages using the Spritz technology. The study timed respondents in two different reading exercises – a short 110 word email and a longer 210 word article – at two different speeds and tested them with seven comprehension questions afterwards. The data revealed that even though Spritz readers are reading at a faster rate, they retained a similar amount of information as traditional readers. Among first time users, the Spritz technology produced at least a 20% faster reading experience with comparable comprehension scores.

Three other studies of text comprehension using RSVP (but not Spritz, specifically) indicated that this method led to comprehension equivalent to that of conventional reading. Potter et al (1980) had participants read paragraphs via RSVP or printed pages (at three rates equivalent to 200, 400 and 600 wpm). The key information was presented at the beginning, middle or end of the paragraph, or was omitted. Both groups of readers (RSVP and printed) had an easier time recalling information from the passages when the topic was introduced in the first sentence, with no significant difference between groups. Nonetheless, detailed recall accuracy for both groups dropped substantially as the rate of presentation increased.

Similarly, Juola, Ward, and McNamara (1982) found comparable comprehension scores between RSVP and conventional reading groups when overall wpm was kept constant. However, similar to Potter et al (1980), scores dropped by about 50% when the text presentation rate was increased. Taken together, these two studies suggest that presentation mode does not seem to interfere with reading comprehension when reading happens at a reasonable speed. However, they also show that when you have a limited time to read a text, there will be comprehension costs either way.

Dingler, Shirazi, Kunze and Schmidt (2015) adopted RSVP techniques for electronic devices by introducing stimuli on text that guide users' eye movements. In a series of two user studies they sped up users' reading pace to 150% of their normal rate and evaluated effects on text comprehension, mental load, eye movements and subjective perception. Results show that reading speed can be effectively increased by using RSVP stimuli while keeping comprehension rates nearly stable. Interestingly, the researchers observed initial strain on mental load, which significantly decreased after a short while. Subjective feedback conveyed that kinetic stimuli (a moving line as underline effect) are better suited for long, complex text on larger displays, whereas RSVP was preferred for short text on small displays.

Although the studies above show that the RSVP paradigm has led to comprehension equivalent to that of conventional reading, results in other studies seem to contradict this claim. Benedettoa, Carbonea, Pedrottic, Le Fevrea, Beya and Baccinoa (2015) had people read on a computer screen a selected part of a book either with Spritz or in the traditional way. The fact that Spritz suppresses parafoveal processing and regressions (i.e. rereadings of words) negatively affected literal comprehension. Furthermore, the researchers concluded that the important reduction of eye blinks observed for Spritz might have contributed to the increase of visual fatigue among their participants.
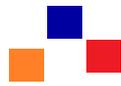
Similarly to Benedettoa et al (2015), Rayner, Schotter, Masson, Potter and Treiman (2016) point out that there is necessarily a trade-off between speed and accuracy in reading. Their theoretical account, based on the reading comprehension literature, suggests that it is unlikely that readers will be able to double or triple their reading speeds (as suggested by Spritz) while still being able to understand the text as well as if they read at normal speed. They add that if a thorough understanding of the text is not the reader's goal, then speed reading or skimming the text will allow the reader to get through it faster with moderate comprehension. In that case, the authors conclude that RSVP apps (such as Spritz) may be of real practical application for wearable technology, such as smartwatches and smartglasses, whose optical display has only enough space to present one or two words at a time.

OVP versus regressive movements during reading: addressing the controversy

Even though there is plenty of evidence in favor of RSVP as a method of word recognition, its usefulness as a technology that would improve reading speed while guaranteeing text comprehension is debatable, as we could see in the studies reviewed in the previous section.

As mentioned before, Spritz claims its effectiveness is related to the fact that readers do not need to move their eyes when they are reading. As it is stated in the app's homepage,

> Removing the eye movements associated with traditional reading methods not only reduces the number of times your eyes move when reading, but also decreases the number of times your eyes must pass over a word for your brain to understand it.

In fact, eye movements while reading are not linear, and previous research using eye tracking found that about 15% of eye movements during reading are regressive (SCHOTTER et al, 2014; for a review on eye movements, see CLIFTON JR et al, 2016). Moreover, many (psycho)linguists see these regressive movements as having a pivotal role in text comprehension, as can be inferred by the use of regressive saccade measures as an indication of processing cost (e.g., RAYNER et al, 2006). The reason why regressions are considered strategic to comprehension is its relation to high-level linguistic operations one must hold to successfully understand the content of a text. The task of comprehending a text involves more than fixating and recognizing a word. It requires the reader to build a coherent discourse representation based on the linguistic cues one finds throughout the text (ZWAAN; RADVANSKY, 1999).

Generally speaking, according to this line of thought, all new information must be integrated to a previous representation, and processes such as the resolution of anaphoric or cataphoric references provides an explicit example of a linguistic operation in which the bounding between a new and an old linguistic expression is essential to
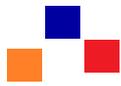
comprehension. As a consequence, anaphoric reference yields regressive saccades as an index of resolution difficulty (KOORNNEEF, 2008; GODOY et al, 2013). Similarly, studies also show that regression saccades are essential to the reanalysis of linguistic input in the light of new information (FRAZIER; RAYNER, 1982; SERENO; BREWER; O'DONNELL, 2006) or to the rereading of mistakenly skipped words (COOK, 2005 apud RAYNER et al, 2006). Removing the possibility of rereading previous words has been shown to impact comprehension of normal sentences or sentences containing structural ambiguity (SCHOTTER et al, 2014), which led linguists to argue against the use of speed-reading apps as a useful tool to read complex or long texts.

Moreover, a fixed reading rate of 200 or 100 words per minute does not comprise the impact linguistic structure has on language processing: pronouns are frequently skipped during reading (GARROD et al, 1994), the last word of a clause takes longer to process and, therefore, to read (RAYNER et al, 2000), predictable words in highly constrained contexts are skipped more often or lead to faster reading times, (EHRLICH; RAYNER, 1981). These and other aspects of language and text structure lead to eye movements that do not follow a linear path from left to right. By removing eye movements of the reading process, Spritz claims to improve reading speed; however, as the previous mentioned studies suggest, these movements do not seem to be a waste of the reader's time, but a strategy necessary to achieve successful text comprehension (SCHOTTER et al, 2014).

Considering the inconsistencies between the research on regressive eye movements, the RSVP paradigm, and Spritz' claims, the main goal of our study is to address the question of whether or not RSVP reading apps, such as Spritz, can maintain global text comprehension as compared to conventional reading. Therefore, two mutually exclusive hypotheses have been put forward: 1) reading comprehension scores generated by Spritz reading will be higher due to the positive effects of RSVP during word recognition and reading, or 2) reading comprehension scores generated by conventional reading will be higher due to the benefits of regressive movements during reading. The instruments and procedures used to test these two hypotheses are explained in the following section.

Method

In order to verify whether the reading comprehension of digital texts is impacted by RSVP (Spritz reading) as compared to the conventional reading of hypertexts, we designed a study in which one group of participants read hypertexts traditionally on computer screens, while another group read the same digital texts on RSVP mode (using Spritz) also on computer screens[3].

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3   Although we acknowledge that the use of mobile devices for participants to read each set of texts on would probably be a more suitable way to address the reading processes under investigation, we feared that different mobile devices, produced by different manufacturers, would represent a confounding variable, since it would be impossible to control which device students would bring to class.

Participants

Fourteen learners of English as a second language (all native speakers of Brazilian Portuguese) integrated the cohort of the study (mean age 25.5, 7 male). All participants were volunteers and were enrolled for a thirty-two hour English course at NucLi, a language program at the Federal University of Rio Grande do Norte (UFRN). NucLi is a language course intended to aid UFRN students taking different majors to evolve as users of English as a second language. In order to participate in the courses, candidates must take the Test of English as a Foreign Language (TOEFL). Their scores, ranging from level A2 to level C1 of proficiency in English (according to the Common European Framework of Reference for Languages), are used as a placement requirement for all courses offered in the program. According to their scores, the participants in our study were placed at an A2 level course, which aimed at developing communicative skills, as well as prepare students to take proficiency exams.
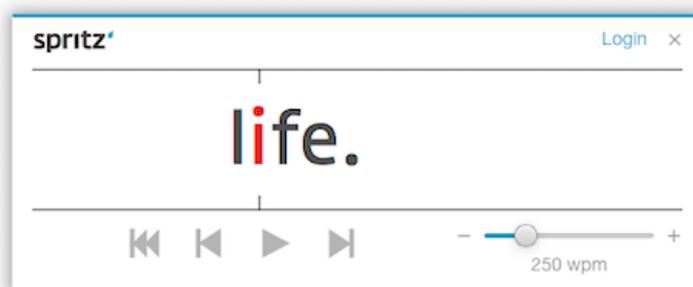
Reading Comprehension Tasks

Stimuli consisted of four texts in English used as practice tests for learners with an A2 proficiency level (basic user), differing only in the presentation mode. Two texts were presented using the RSVP paradigm, with the Spritzlet app (Figure 2), and two texts were presented in a conventional hypertext mode (Figure 3). Two lists were created rotating these two conditions so each text was read across subjects in the two presentation modes. Average text length was 230 words (234 words in the longest text, 225 in the shortest one), and Spritz presentation speed was set to show 100 words per minute (based on a pilot pre-experiment with two A2 participants who stated that this was a comfortable pace to read at).

**Figure 2 – A sample text being read on Spritz mode (RSVP).
OVP is highlighted by the red type inside a "redicle".**

For the stimuli presented in hypertext, the experimenters warned the participants that they would have no more than three minutes to read the whole text (about the same time it took the Spritz app to present each text). All texts used in our experiment were selected from an ESL exam preparation website (http://www.englishaula.com) and were subsequently hosted in a website created for the specific purposes of this study.

Figure 3 – A sample text being read on conventional hypertext mode.

BRYSON THE TRAVEL WRITER

VOLTAR

Bill Bryson, OBE, the best-selling American author of humorous books on travel about Britain, was born in the US on December 8th, 1951, although he lived in Britain for most of his adult life. He returned to the U.S. in 1995 with his wife and four children, who then had the opportunity of learning about life in the US. He felt they would be happier for having lived in two countries, and although he regretted leaving the UK and would like to return, that would not be possible for at least four years, as his daughter Felicity was about to start college there.
He recently returned to England for a short period to work on a radio programme about the English Language and also to talk b a book he had written. Having to go on the road to promote their work is not something most writers like doing, although Bryson doesn't mind it, because it gives him the chance of visiting new places and meeting lots of people.
The luxurious life he enjoys when doing this work in Britain, like being driven around in big cars and staying in expensive hotels, is very different from his normal life in the US. He enjoys this experience because he doesn't have to pay any bills and everybody is nice to him and he has a lot of fun.

Immediately after reading each text, participants had five minutes to answer a comprehension test to assess their performance. The comprehension test consisted of seven multiple-choice questions in which participants had to analyze if the statements about the texts were right, wrong or not mentioned.

Results and Discussion

The total correct answers participants scored in the comprehension test for each text was analyzed considering the presentation mode. As displayed in Table 1, higher means for texts presented using traditional hypertexts were found (3,9 points vs. 3,5 points per text on average).

Table 1 - Descriptive statistics for the two dependent variables - reading scores with Spritz and Hypertexts

Descriptive Statistics

|	N	Minimum	Maximum	Mean	Std. Deviation
Hyper	14	2,50	5,00	3,9286	,70321
Spritz	14	2,50	5,00	3,5000	,70711
Valid N (listwise)	14				

However, no significant effect of presentation mode was found in a Wilcoxon Rank Sum Test (p = 0,146), as displayed in Graph 1, meaning that the way the stimuli were presented did not affect participants' performance in the reading comprehension tests.

Graph 1 - Mean differences in reading comprehension scores in the two reading modes - Spritz and Hypertexts
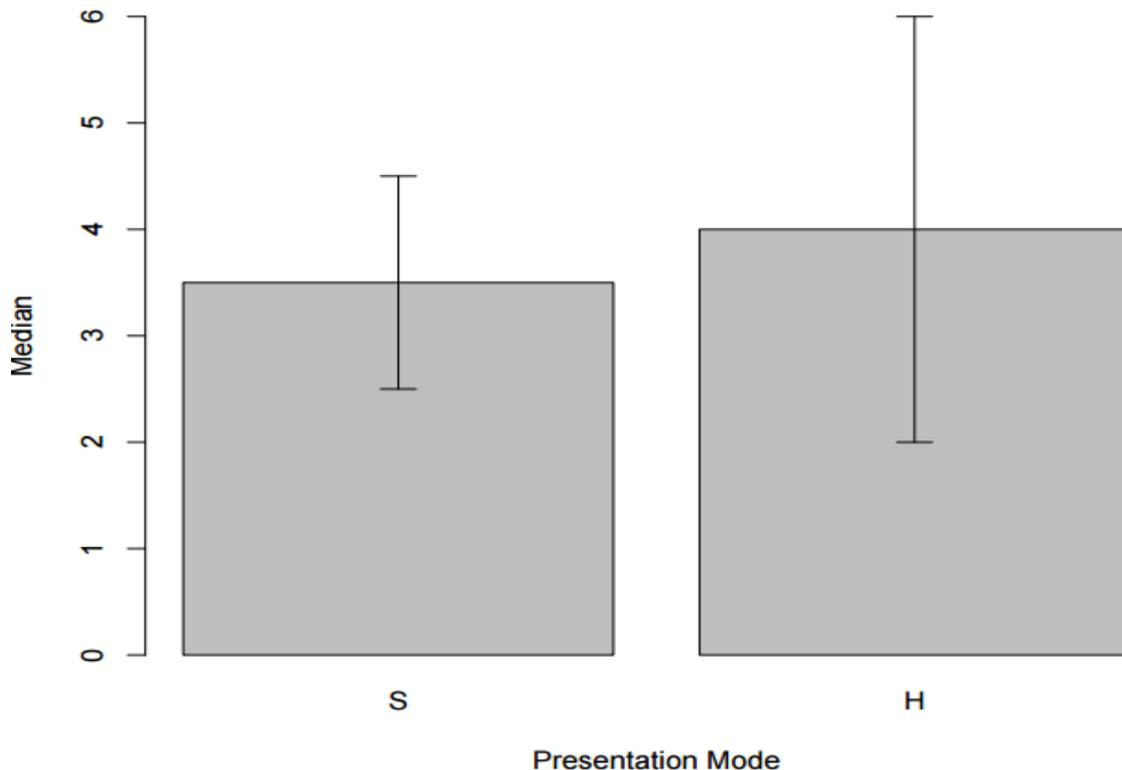
The fact that in the present study reading comprehension accuracy did not interact with mode of text presentation does not allow us to arrive to a firm conclusion regarding our original question. Neither can we confirm any of the two hypotheses put forward, namely that 1) the scores generated by Spritz reading would be significantly higher due to the positive effects of OVP reading, or 2) scores generated by typical hypertext reading would be significantly higher due to the benefits of recurring saccades.

When considering the application of the RSVP paradigm in text reading, Brysbaert and Nazir (2005) ventured that the implications of the OVP phenomenon would be particularly strong for beginning readers, because for quite some time they read text materials word by word. The same researchers hypothesized that the situation would be slightly more complicated for proficient readers, because they pick up information from the parafoveal word $n+1$ while they are still fixating on word n. This means that in text reading proficient readers quite often have rudimentary information about the word, in particular the word beginning, when they land on a word. This advance knowledge is likely to attenuate the OVP effect in text reading
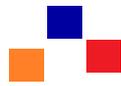
relative to isolated word recognition, as has indeed been observed by Vitu, O'Regan and Mittau (1990). Although this seemed to be a plausible supposition to us at first, leading us to assume that the A2 readers in our study (basic users) might benefit from Spritz reading to a greater extent than from conventional reading, our results failed to support this expectation.

One hypothesis we entertain to explain the lack of significant difference between groups in our study is that, being the mean comprehension scores in the two groups relatively low (3.5 and 3.9 points out of 7), readers of neither group might have not been able to build an ongoing mental model of the entire text as they read it, regardless of the condition in which they read. This floor effect could have happened because participants' reading comprehension was tested in their second language, which may have put an extra load on their cognitive system. In other words, in order to answer the comprehension questions successfully, participants had to retain information regarding the entire text (integrating information across sentences) in long term memory, a process which might have been impaired due to the attention overload caused by insufficient knowledge in their L2. As mentioned before, the task of comprehending a text involves more than fixating and recognizing a word. It requires the reader to build a coherent discourse representation based on the linguistic cues one finds throughout the text (ZWAAN; RADVANSKY, 1999). These processes might have been particularly demanding and, therefore, unattained by our participants.

A second explanation, which also represents a caveat of the present study, refers to the comprehension measure applied. It is relatively easy to measure reading rate by computing the number of words people can read in a given period of time. It is a lot harder to measure comprehension. Although multiple-choice questions – the measure applied in this study – is fairly easy to be scored, and therefore, widely used in reading comprehension research; it is also true that some people are able to do surprisingly well at these tests without actually reading the text (COLEMAN; LINDSTROM; NELSON; LINDSTROM; GREGG, 2010). That means that differences in reading comprehension between conditions might have been there, but did not emerge from the data as a potential artifact of the reading measure applied. Therefore, alternative ways to measure reading comprehension, such as open-cloze texts or asking readers to provide a summary of what was just read, should be considered as well by future studies.

Despite the lack of significant results, an interesting finding in our study was the low correlations between participants' reading scores in the two conditions (Spritz and Hypertext). A low Spearman correlation coefficient (rho=.009, *p*=.975), depicted in the scatterplot in Graph 2, indicates that there seems to be different mechanisms and processes mediating reading in the two modes, since the readers who had higher scores on Spritz were not necessarily the same who had the best scores in reading conventional hypertexts and vice versa.

Graph 2 - Scatterplot of reading comprehension scores in the two reading modes - Spritz and Hypertexts
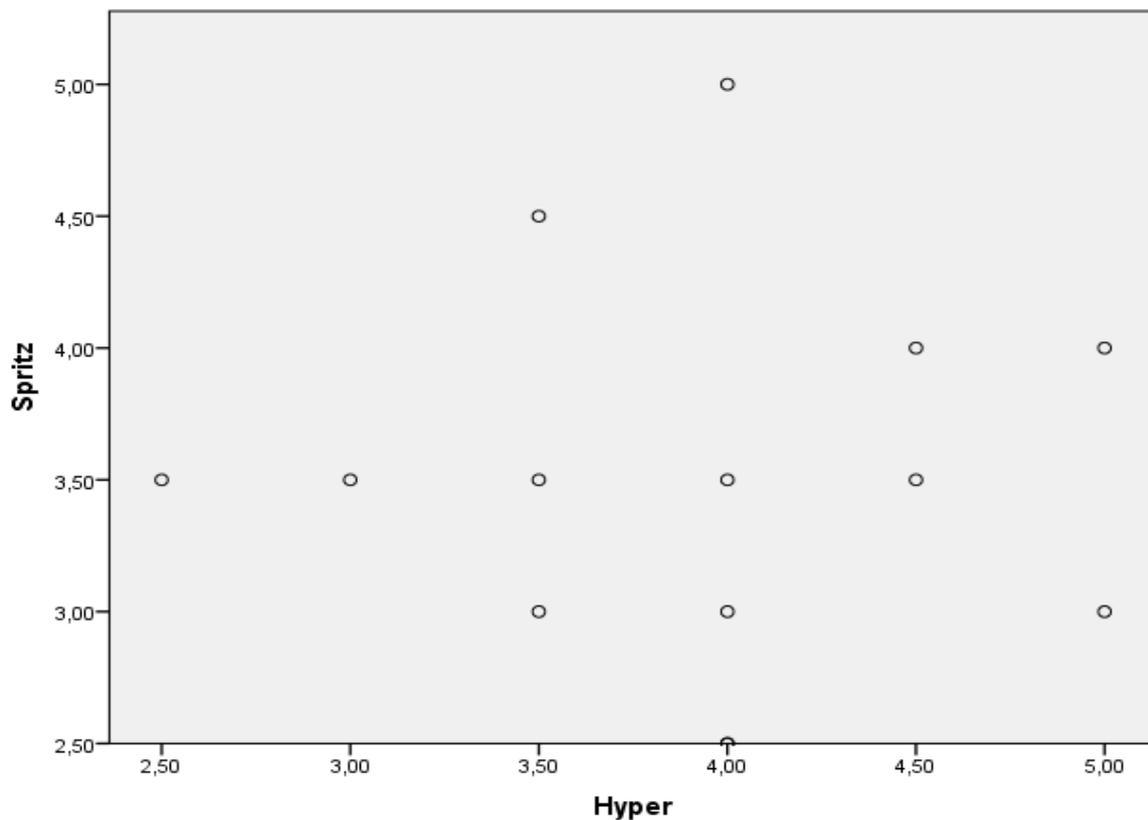
One implication of this finding may be that different people benefit from different modes of text presentation in different ways. The design of our study does not allow for any conclusion to be made regarding individual differences in reading skills, especially due to its reduced sample size. However, we believe that that is an interesting question to motivate future investigations.

In order to address the individual differences issue, a logical next step might be to replicate this experiment considering different reading populations, such as poor versus good readers, or dyslexic versus non-dyslexic readers. A hypothesis one can advance at this point is that poor readers or people with reading difficulties might benefit more from Spritz reading than from reading conventionally, since crowding and distractor effects are believed to be reduced in such mode.

Crowding is a general phenomenon associated with impaired visual object identification in cluttered scenes (CHANCEAUXA; MATHÔTA; GRAINGERA, 2013; HUCKAUF; NAZIR, 2007). Although the underlying mechanisms of crowding are still not completely understood, one popular account is that it results from excessive pooling of featural information such that the visual features associated with a given target at a given location are mixed with the features associated with nearby stimuli (e.g., PELLI; PALOMARES; MAJAJ, 2004), therefore overloading one's visual attention. When we read normally, our brain is not only busy processing the words inside of your foveal vision as ORP positions are encountered, but also scans ahead for an indication of what is coming up from your parafoveal vision. This can be particularly difficult for people with impaired reading skills, with limited visual attention and phonological skills.
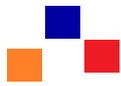
With RSVP methods, Spritz included, the brain cannot depend on parafoveal cues to tell the eyes where to jump to next. When the brain cannot use its parafoveal vision to help the eyes saccade to the next word, it starts over with every new word it encounters. Therefore, proper positioning that does not require eye movement is crucial to 'helping' the brain process words, especially at speed. Considering people with reading difficulties, since their eyes do not need to move while spritzing, their brain may quickly becomes comfortable with not needing the additional information from parafoveal vision; thus avoiding crowding effects and the consequent overload in their visual attention field.

In that direction, Shaywitz (2005) points out that it is important to find ways of providing accommodations for people with reading disabilities. According to the author, dyslexics and poor readers in general benefit from adapted texts (with more space between lines, more breaks with subtitles between paragraphs, more image support), and also from advanced computer technology. In that sense, the Spritz app comes as a potential aid, which may help readers with difficulties to adjust reading to their specific needs, by presenting a word at a time on the screen and; therefore, avoiding the aforementioned crowing effects caused by the merging of words on the page. However, given beneficial results are indeed found by future studies with populations with reading difficulties, an important claim needs to be made: all computer apps applied to Education require care and fine-tuning. It is advisable that, before the implementation, the people involved are provided with the understanding, guidence and practice that such sophisticated tools require.

Conclusion

In this paper, we aimed at examining whether there are differences in reading comprehension using Spritz - a digital tool which presents words one at a time on screen, at different speed – as compared to conventional hypertext reading. Although higher means for information presented using traditional hypertexts were found, no statistically significant effect of presentation mode was revealed.

Some intriguing questions can be raised as a result of this study. Are the mechanisms and processes which mediate reading in the two modes similar or different? Do different people benefit from different modes of text presentation in different ways?

As claimed in the Results and Discussion section of this paper, future research should compare participants performances on L1 and L2 reading, consider other measures of reading comprehension, and should focus on atypical reading populations, such as dyslexics, for example. Moreover, studies should include reading time as a dependent variable, and have participants read the texts on digital mobile screens instead of computer screens.

All in all, we hope to have contributed to the debate among RSVP versus conventional reading, by shedding some light on the discussion and, inevitably, raising more questions. We believe further research about the visual and mental processes underlying reading, being it mediated by technological advances or not, is highly in call for.
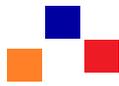
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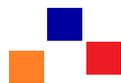
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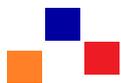
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