advantages of RSVP on an aging reading population, finding that the benefits of RSVP did not decrease as visual acuity and contrast sensitivity decreased. Finally, visually impaired, dyslexic and less efficient readers have also been proposed to benefit from RSVP displays (Chen, 1986; Potter, 1984; Williamson, Muter, & Kruk, 1986).

Many RSVP commercial applications have been recently developed for both Android and Apple platforms (e.g. A Faster Reader; Balto Speed Reading; RapidRead; Speed Book Reader; Speed Reader Spritzer; Speed Reading; Speedy-Speed Reading; Spree; Spritz; Velocity), however one of those – that we investigate here – has recently gained visibility: we are talking of Spritz. The novelty of Spritz lies in the combination of a single-word stationary RSVP with the Optimal Recognition Point (ORP) also known as Optimal Viewing Position (OVP), the letter most crucial for the brain to process the meaning of a word. The location of the ORP has been largely investigated and depends on the length of the word: the longer the word, the farther to the left of center the eyes must move to locate the ORP (for a review see Brysbaert & Nazir, 2005). In Spritz every ORP is highlighted in red and displayed in the same location on the Spritz's display, so that the reader's eyes are always focused on the same location and no saccades – even very small ones – are required. Other innovations of Spritz concern the time words are displayed and the pause length between sentences. In Spritz longer words are displayed longer and longer sentences have longer pauses at the end of the sentence (see Maurer, Klein, & Waldman, 2014, for further details).

The general idea that RSVP has a disadvantage over traditional reading lies in the fact that – with RSVP – eye movements are almost removed from the reading process (Masson, 1983; Rayner, 2009). Although few studies support the idea the elimination of eye movements would lead to a possible reduction in cognitive load (e.g. Potter, 1984), this assumption cannot be supported (Castelhano and Muter (2001). By requiring eye movements to be suppressed, RSVP may actually increase cognitive load and distract the reader from the content of the passage being read (Bouma & De Voogd, 1974). During reading, the eyes follow the direction the text is written. However, about 10–15% of the time spent for reading is made of regressions. Regressions are backward gazes moves within a line, produced to re-examine material not clearly perceived or understood (Rayner, 2009). According to Schotter, Tran, and Rayner (2014), the control over the sequence and duration of word processing, as well as the control of the oculomotor system, are crucial to accurate comprehension of text, and the functional removal of regressions jeopardizes comprehension. However, the possibility to make regressions is not the only element that discriminates traditional reading from RSVP. A large body of literature has proven that readers access information from words before fixating them by means of the so-called parafoveal processing (Rayner, 2009). The acquired information is then used to ease processing once the words are directly fixated (Schotter, Angele, & Rayner, 2012). Since in Spritz words are presented one at a time, parafoveal processing cannot occur.

Besides comprehension, a very interesting and unexplored topic seems to be the relationship between visual fatigue and RSVP. Visual fatigue (sometimes referred to as asthenopia or eye strain) is a subjective visual disturbance, characterized by fatigue, pain around the eyes, blurred vision or headache (ICD-10, H53.1). According to Sheedy, Hayes, and Engle (2003), external visual fatigue symptoms could be attributable to the dry eye syndrome, an eye disease caused by either decreased tear production or reduced blinking. Therewith, changes in visual fatigue can be can easily detected by monitoring changes in eye blinks, namely decreased frequencies as visual fatigue raises (Benedetto, Drai-Zerbib, Pedrotti, Tissier, & Baccino, 2013; Rosenfield, 2011; Benedetto, Carbone, Drai-Zerbib, Pedrotti, & Baccino, 2014). Blinks are generally inhibited during tasks that require sustained visual attention and tend to occur immediately before or after the task (for a review see Stern, Walrath, & Goldstein, 1984). According to Nakano, Kato, Morito, Itoi, and Kitazawa (2013) eye blinks are actively involved in the process of attentional disengagement during cognitive tasks by momentarily activating the default-mode network (usually involved in wakeful rest), while deactivating the dorsal attention network. Since the RSVP entails large amounts of visual attention, a drop in the frequency of eye blinks should be expected. Additionally, the radical minimization of saccades induced by this reading modality, might even amplify the negative effect on visual fatigue. Since saccadic gaze shifts are often accompanied by blinks, a reduction of saccades will generate a consistent drop in eye blinks (e.g. Evinger et al., 1994; Watanabe, Fujita, & Kyoba, 1980).

According to Spritz's developers, the elimination of saccades should reduce eye fatigue and improve comprehension, even when dealing with long texts (Maurer & Tocke, 2014; Maurer et al., 2014). Since these claims do not seem to be supported by any scientific evidence, we believe they need to be investigated. In this study, we had people read on a computer screen a selected part of a book (Orwell, 2004) either with Spritz or in the traditional way (i.e. left-to-right, top-to-bottom), and tested the effects of the two reading modalities (i.e. Spritz vs. Traditional) on comprehension, visual fatigue, performance, task load and ocular behavior using ocular, performance and subjective measures.

2. Materials and methods

2.1. Participants

Sixty participants (30 females, mean age = 28 years, SD = 9) were recruited and gave written informed consent before the experiment begun. All of them were native French speakers, were naïve as to the aims and the expected outcomes of the experiment and had normal or corrected-to-normal vision (contact lenses were accepted but not glasses). None of them had previous experience with the Spritz application. According to the International Standard Classification of Education (ISCED, 2011) participants' median level of education was 6 (i.e. Bachelor or equivalent). Either a monetary compensation (10 €) or school credits were offered to participants for their participation in the study. The study was performed in keeping with the Declaration of Helsinki. An internal committee board approved the protocol.

2.2. Apparatus

Eye movements were recorded with an infrared video-based eye tracker (SMI RED 5; www.smivision.com). Sampling rate was set to 500 Hz, and a 5-point calibration was made for each participant at the beginning of each reading trial. Ambient lighting and screen luminance were kept constant during the whole experiment, as assessed by a digital light meter (Extech 403125; www.extech.com). The average distance between participants and the 22" LCD screen (Dell P2210; www.dell.com) employed for the reading task was 70 cm. Screen size was 474 (horizontal) × 297 (vertical) mm. Screen resolution was set to 1280 × 768 px.

2.3. Stimuli

Two types of reading modalities were compared in this experiment: Spritz vs. Traditional. Variables such as font size and typeface were not manipulated and were kept constant during the whole experiment and across the two experimental conditions. In this way, that the only difference resided in the way the text was displayed. As to Spritz, the software employed for simulating the RSVP procedure was developed according to the information

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