Application of Spritz to the Dynamic Presentation of Text in Project Documentation

Mark Leman

Mark Griffin, Mark Pegrum
School of Psychology, Graduate School of Education

Jeremy Leggoe
School of Mechanical and Chemical Engineering

Mark Titley, Susmita Thomson
CEED Client: Chevron Energy Technology Company

Abstract

With advancing technology, the ability to provide on-demand information to workers on-site through portable handheld and wearable devices has the potential to increase efficiency and improve execution of tasks. A possible solution to limited screen space on handheld devices is offered by commercial applications (app), such as 'Spritz', which presents rapid streams of text in a sequential order inside a small reading window. The objective of this study is to conduct a proof of concept assessment of Spritz as a novel reading tool for the efficient reading and comprehension of engineering documentation. Reading experiments involving 100 participants have been conducted to study the effects of reading using Spritz on comprehension and memory retention.

The study finds that reading technical documents, such as a Material Safety Data Sheet (MSDS), in Spritz resulted in lower literal comprehension compared with reading in a traditional format, and that having familiarity with the content did not sufficiently compensate for this comprehension deficit. Without modifying the way text is presented in Spritz, it may not be a feasible platform for reading technical documents. Further investigation into semantic chunking of information and text navigation for Spritz are currently underway and may help address these shortcomings.

1. Introduction

In many oil and gas operating companies, procedures are currently available in the form of paper documentation, or on large electronic device. Operators may not always have access to the relevant procedures whilst in the field when conducting tasks and must rely on memory. Memory reliance may result in an increase of risk of human errors, for example misinterpretation of procedures, omitting a critical step in procedures, performing a step too soon or too late, and performing steps in the incorrect sequence. Ease of access to relevant procedures and documents such as from small, portable devices that are intrinsically safe may help support safe, accurate and efficient execution of tasks.

The client proposed that UWA review a commercial app called Spritz as one way of providing access to information using portable devices. Spritz utilises Rapid Serial Visual Presentation (RSVP), a method of text presentation where text is streamed in rapid succession on a fixed location on the screen, allowing reading of text even in a limited amount of space

(Maurer & Locke 2014). It is claimed that this technology may help improve the readability of text on small screen sizes, and also increase reading efficiency (Choi 2014).

The aim of this project is to study the efficacy of Spritz in comparison to traditional reading when reading technical documentation, particularly focusing on the reader's comprehension levels. A quantitative assessment has provided an indication of the viability of Spritz as an alternative reading tool for oil and gas operators. This helped understand the potential use and benefits of the technology for the company.

1.1   Literature Review

During traditional reading, readers spend 10-15% of their time executing eye movements (saccades) to follow the text and also make backward gaze movements (regressions) when a word is not fully understood, thus creating an upper limit on reading speed (Rayner 2009). RSVP is based on the premise that by eliminating eye movements, attentional focus is increased, resulting in improved reading speed without compromising comprehension (Rubin & Turano 1992).

Spritz is a modified form of RSVP where the central point of each word is highlighted, causing the reader's eyes to focus on the same location, and completely eliminating eye saccades. Additionally, Spritz has optimised the display time for each word, along with the pause length for punctuation and between sentences (Maurer & Locke 2014). Spritz's modifications to RSVP are claimed to reduce eye fatigue and improve comprehension even when reading long texts (Maurer & Locke 2014).

Some empirical studies have shown that using Spritz does not cause a significant reduction in comprehension, and thus may be an effective alternative to traditional reading. However, numerous other studies have indicated that Spritz adversely affects comprehension. An explanation is that regressions may actually aid in post-processing of words that are not clearly understood (Rayner 2009). In traditional reading, readers may also benefit from seeing subsequent words in a sentence. This results in parafoveal processing, where the brain pre-processes these words, assisting comprehension (Hohenstein & Kliegl 2014). The fact that Spritz eliminates regressions and parafoveal processing may in fact cause decreased reading comprehension.

**Figure 1   Spritz Interface with Optimal Recognition Point (ORP) highlighted
(the letter "s")**

With conflicting literature findings, an experiment was conducted to confirm Spritz's efficacy and viability as a reading tool. From the literature review, no previous studies have focused on the effects of **familiarity with subject material** on comprehension levels when presented with information in Spritz format.

2.   Application to Material Safety Data Sheet (MSDS)

2.1   Outline

Reading experiments were conducted with University of Western Australia (UWA) students at the UWA Accelerated Learning Lab to study and quantify the impact of reading a Material Safety Data Sheet (MSDS) in Spritz format compared to traditional format. In particular, the experiment explored the hypothesis that Spritz may perform better when relaying information that readers are familiar with. This has helped understand whether the technology is better used as an efficient refresher tool rather than for learning new materials.

A MSDS of Benzene was used as the basis for the study in agreement with the client. Since Benedetto et al. (2015) found that Spritz had a negative effect on comprehension when applied to reading long (>25mins) and technical texts, and given the lengthy nature of an industry-standard MSDS, the document was synthesized such that it could be read in 3 mins for the purposes of this study.

2.2   Experimental Design

A single-measure, between-subjects experimental design was used, where participants were randomly assigned into four distinct condition groups, shown below in Table 1. To study the effects of familiarity, a pre-reading was given. Groups 1A & 2A were given the relevant MSDS on Benzene, whilst Groups 1B and 2B were given an irrelevant MSDS that contained information on a different chemical which was not tested. Participants were not aware of whether their pre-reading contained relevant information for the test. All groups then received the relevant MSDS after the pre-reading. All Spritz groups read at 250 words per minute (wpm), which is the average human reading speed (Benedetto et al. 2015).

	Familiar with Content	Unfamiliar with Content
Spritz format	Group 1A	Group 1B
Traditional format	Group 2A	Group 2B

Table 1   Condition Groups for Experiment on MSDS

The measured variable in the study is each participant's level of comprehension following reading. A quiz consisting of 20 multiple choice questions was administered immediately after reading, and the resulting scores were recorded. These questions consisted of:
- Literal Comprehension (15 questions) – measures ability to recall explicit information such as the boiling point of a substance
- Inferential Comprehension (5 questions) - measures ability to apply information to decision-making when given a real-life scenario

2.3   Hypotheses and Analysis

The following null hypotheses were tested for the study:
1. $H_{0,A}: \mu_{1A} < \mu_{2A}$. For participants who are familiar with the MSDS, the Spritz group should have lower comprehension than the traditional format group
2. $H_{0,B}: \mu_{1B} < \mu_{2B}$. For participants who are unfamiliar with the MSDS, the Spritz group should have lower comprehension than the traditional format group

3. The comprehension deficit between Spritz and traditional groups should be lower for the familiar group than for the unfamiliar group. In other words, does familiarity compensate for the comprehension gap inherent in reading with Spritz?

The measure of success for Spritz is to accept hypothesis 3. Analysis was conducted using IBM SPSS to compare differences in comprehension scores between the groups. The validity of the null hypotheses were tested using Analysis of Variance (ANOVA) and t-test methods. A 95% confidence interval has been used for all tests for statistical significance.

3.   Results and Discussion

3.1   Key Findings

100 UWA students participated in the experiment, of whom 36 were engineering students and 64 were non-engineering students. This sample size was sufficiently large to ensure that results have significant statistical power. Statistical analysis has shown that engineering students did not consistently score higher than non-engineering students. For the purposes of this analysis, both types of students were treated on the same grounds.

Condition Group	Mean and (Standard Deviations) of Scores	
	Literal Comprehension (/15)	Inferential Comprehension (/5)
1A: Familiar Spritz	10.8 (2.7)	3.2 (0.7)
1B: Unfamiliar Spritz	8.6 (2.4)	3.4 (1.1)
2A: Familiar Traditional	12.2 (2.2)	3.5 (1.1)
2B: Unfamiliar Traditional	10.8 (2.5)	3.4 (1.1)

Table 2   Mean and Standard Deviation of Scores for each group

Observing the inferential comprehension scores, they seem to be relatively constant between the groups. This is verified by an ANOVA which revealed no interaction between reading format and inferential comprehension $F(1,96)=0.039$, $p=0.844$, and familiarity on inferential comprehension $F(1,96)=0.622$, $p=0.432$. Based on this, Spritz does not negatively affect the ability to apply information to decision making.
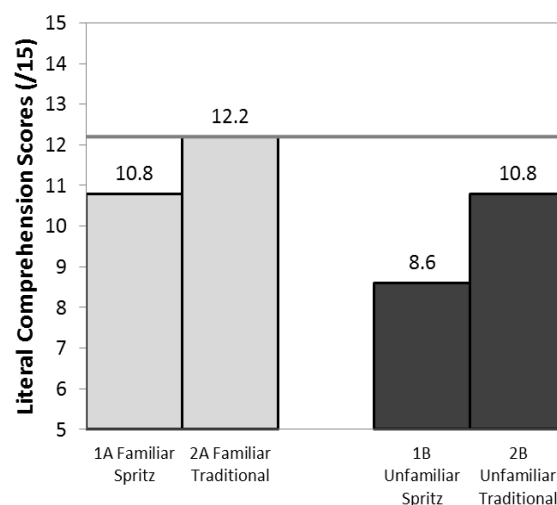

Figure 2   Mean of Literal Comprehension Scores between Each Group

Considering literal comprehension in Figure 2, there seem to be comprehension deficits that resulted from using Spritz when compared to the traditional group. Group 1A, who used Spritz and were familiar with the content, only performed equally as well as Group 2B, who read in traditional format but were unfamiliar with the content.

Having familiarity with the content, however resulted in a slight improvement in literal comprehension for Spritz. The difference in the comprehension scores between the Spritz and Traditional groups were lower for the familiar group (1.4), compared to the unfamiliar group (2.2). Upon analysis, the improvement was however not large enough to be statistically significant.

3.2   Statistical Analysis

Condition Groups	Test	Purpose	p-value	Statistical Significance (p<0.05)
1A x 2A	t-test	Effects of Reading Format on familiar group	p=0.046	Yes
1B x 2B	t-test	Effects of Reading Format on unfamiliar group	p=0.003	Yes
1A x 1B	t-test	Effects of Familiarity on Spritz group	p=0.005	Yes
2A x 2B	t-test	Effects of Familiarity on traditional group	p=0.044	Yes
Familiarity x Reading Format	Two-way ANOVA	Interaction between Familiarity and Reading Format	p=0.442	No

Table 3   Statistical Tests on Literal Comprehension Scores Between Groups

Table 3 above summarises the statistical tests conducted on literal comprehension scores, determining whether there was a statistically significant difference in scores between each combination of two groups. Based on a 95% confidence interval for the t-tests, each dependent variable tested (reading format and familiarity) yielded statistically significant effects on literal comprehension levels. Reading in Spritz caused a statistically significant drop in comprehension for both familiar and unfamiliar groups. But on the other hand, familiarity with content slightly compensated for this drop in comprehension, with statistically significant effects on both Spritz and traditional groups. In light of these results, we do not reject the hypotheses 1 or 2. Furthermore, a two-way ANOVA revealed no interaction between familiarity and reading format, hence do not accept hypothesis 3.

4.   Conclusions and Future Work

The results from this study have shown that using Spritz to read a technical document such as an MSDS appeared to reduce literal comprehension, but not inferential comprehension. One question was whether having familiarity with content would sufficiently compensate for the comprehension gap resulting from the use of Spritz. Based on our study, we conclude that familiarity with content does not sufficiently compensate for the lietral comprehension deficit. In its current unmodified state, Spritz may not be suitable for reading technical documents such as the MSDS.

Further experiments are currently underway to determine if semantic "chunking" of information (subdividing information into a visible content hierarchy) and improving text navigability (ability to read sections selectively) can help improve comprehension in Spritz. This involves software development of a menu interface using Adobe Flash and ActionScript 3.0, as depicted in Figure 3.
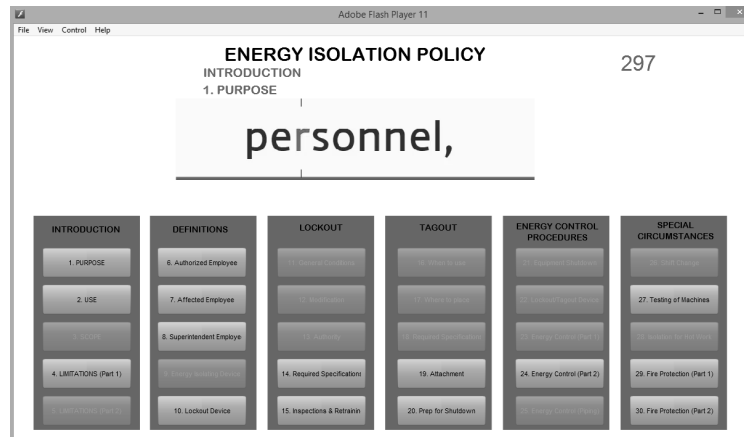

Figure 3   Menu interface developed in Adobe Flash using ActionScript 3.0

5.   Acknowledgements

6.   References

Benedetto, S., Carbone, A., Pedrotti, M., Le Fevre, K., Bey, L. A., & Baccino, T., 2015, 'Rapid serial visual presentation in reading: The case of Spritz', *Computers in Human Behaviour*, vol. 45, pp. 352-358.

Choi, L., 2014, 'Spritz technology compels faster reading without sacrificing comprehension', Penn Schoen Berland.

Hohenstein, S., & Kliegl, R., 2014, 'Semantic preview benefit during reading', *Journal of Experimental Psychology: Learning, Memory and Cognition*, vol. 40, no. 1, pp. 166-190.

Maurer, M., & Locke, J., 2014, Retrieved from 'Why Spritz Works: It's All About the Alignment of Words'.

Rayner, K., 2009, 'Eye movements and attention in reading, scene perception, and visual search', *The Quaterly Journal of Experimental Psychology*, vol. 62, pp. 1457-1506.

Rubin, G., & Turano, K., 1992, 'Reading without saccadic eye movements', *Vision Research*, vol. 32, pp. 895-902.