Effectiveness of the Auditory and Visual effects of Chinese e-Magazine on the Graduate Students' Reading Process

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Abstract

We are in a digital society where new technologies are constantly emerging and old technologies are being upgraded faster than we can take in. Digital reading has become an important means of reading, but the visual process for digital and paper reading is different. With the eye tracking technique, the orthogonal design and the regression model, this paper, analyzes audiences' eye movement when reading Chinese e-magazine under visual and auditory stimulations. An experimental e-magazine was created and 80 graduate students were randomly selected. All participants underwent the same setup but under different stimuli; they had to read short sentences while an eye tracker recorded their eye movement; after completion, participants answered a comprehension questionnaire. The most important results, analyzed in terms of eye fixations, are that text dubbing and background colors have a significant effect on reading comprehension, which means that using text dubbing and cool colors can lead to a better reading comprehension. The findings obtained reveal a better knowledge of the e-magazine reading behavior and it can be applied to the design of digital magazines. However, it is necessary to perform specific cross-cultural studies and to unify the units of measurement of eye tracker and the units of measure of reading effectiveness.

Keywords: e-magazines, attention, eye tracker, digital context, reading, multimedia resources.

Resumen. *Eficacia de los efectos auditivos y visuales de las e-revistas chinas en el proceso de la lectura de los estudiantes universitarios*

Estamos en una sociedad digital, donde constantemente están surgiendo tecnologías nuevas y las viejas se actualizan más rápido de lo que a menudo podemos asimilar. En este contexto, la lectura digital se ha convertido en un importante medio de lectura, si bien el proceso visual de la lectura digital y la tradicional (en papel) es diferente. Con la técnica del seguimiento ocular (*eye tracking*), un diseño ortogonal y la aplicación del modelo estadístico de regresión, este trabajo analiza el movimiento ocular de los sujetos al leer una e-revista en chino que contiene estímulos visuales y auditivos. Se crea una revista experimental y se seleccionan al azar ochenta estudiantes. Todos los sujetos participan en la misma situación experimental pero por diferentes condiciones estimulares; durante la experimentación los participantes leen textos cortos de la e-revista mientras se registran con el *eye tracking* sus movimientos oculares; al finalizar, responden un cuestionario de comprensión. Los resultados más importantes, analizados en términos de fijaciones oculares, muestran que el texto doblado y el color de fondo tienen un efecto significativo en la comprensión lectora del texto. En general, los resultados obtenidos revelan un mejor conocimiento del procesamiento visual y cognitivo de la lectura de la e-revista y se pueden aplicar en el diseño de revistas digitales. Sin embargo, es necesario realizar estudios interculturales específicos y unificar las unidades de medida tanto de los parámetros del *eye tracker* como de la eficacia lectora.

Palabras clave: revistas digitales, atención, *eye tracker,* contexto digital, lectura, recursos multimedia.

1. Introduction

We are in the digital society where new technologies are constantly emerging and old technologies are being upgraded faster than we can take in. The digital way of living has already become a part of people's daily lives. In this context, digital reading has become an important means of reading and the publishing industry is also evolving in this trend (Roschke and Radach, 2016).

The thirteenth National Reading Survey (2016) shows that Chinese people's digital reading rate has reached 58.1%. Digital books are increasingly popular. According to the study of Cassassus (2015), 15 to 20% of the book reading public will own electronic devices suitable for reading digital books and 25% of all books sold will be in a digital format by 2015. In 2016, more than 50% of the people read on electronic devices as mobile phones and online platforms (Roschke and Radach, 2016).

It can be accepted that digital media contribute to a transformative shift in reading and also introduce a lot of advantages such as interactivity, non-linearity, immediacy of accessing information, and the convergence of text and images, audio and video, which are traditionally absent in printed environment (Landow, 1992; Lanham, 1993; 1994; Murray, 1997; Ross, 2002). Neither research nor science is saved from media excesses (Martínez-Salanova, 2013) and digital books constitute one of the technologies to which great attention has to be paid (Minelli, Camacho and Gisbert, 2014). Reading digital publications, however, is different from reading paper-based

publications (Zhang and Añaños, 2014). Only visual stimulation participates in the reading process of paper-based publications while both visual and auditory stimulation, participate in the reading process of digital publications. According to Canavilhas (2007), *multimediality* can be understood as the possibility that the information of informative websis displayed with such different characteristics, such as text, video or audio.

The eye tracker research technology is highlighted in this study, since it is the technology that has been most used for the study of eye movements that occur during reading and is also used in the experimental part of this paper (Rayner, 1998). The first studies on reading Chinese using the eye tracking technique were carried out by Yu, Tang, Sue and Li (2006) with reading newspapers design. Their results pointed out that the main information needed to try is placed in the primary visual areas while color factors point out main information. Jiang (2007) provides some suggestions such as Chinese reading is easier to identify in one column design and so is English reading; but Chinese reading is faster in two columns design.

The eye tracking methodology has been applied extensively in the research learning (Lai *et al.*, 2013 cited by Rovira, 2016), especially in understanding of pressure reading. It is a methodology to obtain clues about the cognitive processes that bring into play their jects as interact with this type of instruments (Rovira, 2016). Reading behavior studies change with the different media (Murphy *et al.* 2003). According to our previous studies, the visual process of digital and paper reading is different in terms of heat map since the number of fixations in digital reading is higher than in paper reading: in the digital reading process, no hot zone is formed and the reader's attention is distributed equally on the whole screen; while in paper, in the reading process the eye gaze is stopped in certain areas of the text (Zhang and Añaños, 2014).

There are some studies carried out with eye tracker technology that analyze the relation between visual variables and the eye's movement in digital reading; its results conclude that illustration with background color is better than illustration without background and that complex background is good for solving difficult questions (Han and Ren, 2003). After that, the reading study focuses more on the effect of the combination of pictures and words and some important conclusions are that pupil size is a good sensitive indicator that can reflect people's information needs. During the process of watching stimulus, the location of the text as well as the evaluation of the level of advertisement would cause a change in pupil size but does not have any effect on fixation duration (Ding, Wang and Zhang, 2005). However, reading and the role of illustrations once aroused a controversy. Samuels (1970), who represents attention-focused theorists, argues that in order to do orthographic tasks, illustrations interfere with the reading process. Paivio and Csapo (1973) believe that compared with the single code words, pictures have double coding and have the advantage of being remembered much easier than words. Donald (1979; 1983), who represents psychological linguists, believes that illustrations provide contextual information to help understand and support information; while Nelson and Castano (1984) believe that the

reason why pictures have the advantage over text is that their discrimination of visual features is bigger. Recently, the eye tracker study of Añaños and Astals (2013) shows that the inclusion of an image in the original stimulus causes considerable attention over the image and a decrease of the visual focus on the text; finally visual impact depends on the characteristics of the formats (Añaños, 2011). But, these results are different when the picture refers to advertising stimulus so in this case the appearance of images does not change the user interaction in terms of eye fixations (Ortiz-Chaves *et al.*, 2014).

Another type of research with eye tracker technology was carried out in order to study the relation between visual webpage elements design and surfer behavior. Some important conclusions are that user expectatives towards the webpage elements depend on the spatial location of the elements and on the interactive behavior with the website elements as the interactive behavior increases the number of cues (Terenzi, Di Nocera and Ferlazzo, 2005). Also, there is not specific research on the effect of background color made with eye tracker technology; authors such as Gao and Xin (2006) have revealed the cognitive and emotional effects of colors, especially the variables warm and cool.

It is evident that there is scarcity of research on sound, understood as a form of communication, as a form of experience and as a resource for cultural expression and social interaction. The current renewed interest in studies on the effects of sound may be the result of the reconfigured media environment in which the sound has become fashionable (Bruhn, 2010). In terms of scientific research, sound and music have been historically passed over in favor of image (De Aguilera and Adell, 2010) and the music effects on the digital readout have been studied less than the visual effects. Some results show that pre-music promotes reading efficiency, reduces the diameter pupil and changes the number of fixations and the eye movement patterns (Chen *et al., 2008).* In general, music led to the decreased of the cognitive processing and it had a greater impact on complex problems. Also music leads to extending the cognitive processing time and to reducing the processing speed. Music also changes the eye movement patterns in the recognition (Sui, Wang and Qian, 2008).

What about the study of content processing and reading comprehension in digital reading? Researchers believe that the gaze duration is the best indicator to measure the processing time of a word (Just and Carpenter, 1993). Gaze duration is the total fixation time before the fixation point fell onto another word (Zhang and Ye, 2006); when the reader has difficulty in processing a word, they will probably extend gazing time on this word and they will also gaze at this word one more time. The saccade distance is another indicator of the reading process. Studies with eye tracker technology show that a bigger saccade distance means decreasing the number of fixationsI It means that during one fixation the reader gains more information and high reading efficiency; aversely, a smaller saccade distance means that the number of the fixations increase because they find difficulty in the reading process (Yan and

Bai, 2000). Therefore, the saccade distance reflects the information extraction and it is an important indicator to reflect comprehension efficiency and content processing, although the comprehension reading will not be affected by different medium (Zhang and Añaños, 2014). Xu (2011) conducted an eye-tracking experiment in reading multimedia material in four conditions: only text, text + graphics, graphics + dubbing, text + graphics + dubbing. His conclusions are that text and graphics have, together, a positive impact on reading efficiency.

Media is an extension of man (McLuhan, 1994). When it comes to the booming of digital reading, protest and praise from both sides are obvious and researchers in the field of digital reading can be divided into conservatives, who worry about declining in reading in print; and the progressives, who embrace the digital developments. Every significant development has its own advocates and opponents, some more realistic than others (Bakker, 2009). Wolf (2008) shows the pessimism about the influence of the digital medium in our reading brain She pointed out that modern readers, who can access online information immediately, run the risk of under-developing their brain capacity whether they learn to "go beyond the text". One of the influences of the digital media is that it decreases the effect of attention and cognitive ability, preventing the reader from following the narrative description of a story (Van der Weel, 2011). According to our last study (Zhang and Añaños, 2014), visual process of digital and paper reading is different in terms of visual attention, but digital reading will not lead to shallow reading. The development of digital readout will end when digital natives can no longer maintain the classic reading (Bennett, Maton and Kervin, 2008; Giffard, 2009).

It has to be taken into consideration the fact that traditional media forms which mainly use text have been unable to meet audiences' needs. Digital media forms with the combination of audio and visual are emerging; for example e-magazine, as a collection of multimedia manifestations. The characteristic of electronic magazines is that they have several effects to enhance the visual effects. While reading e-magazines, readers are often attracted by a variety of special effects, but it is possible that the special effects disturb while reading text, reducing the reading efficiency.

As seen, all studies about reading behaviors focus on single visual stimulation or single auditory stimulation and there is no study about reading behaviors under both, visual and auditory stimulation (Peng, 2010). Therefore, the basic behavior study of digital reading is not yet covered. This experimental study aims to fill a gap in the effects of the interaction of the visuals and auditory stimuli on reading efficiency. According to the classification of research in communication by Milajovic, Klent and Ninkovic (2013) this work can be considered as a study of textual features and interactivity, of the least studied research in communication.

2. Objectives and hypotheses

This paper focuses on the behavior of Chinese digital magazines readers under visual and auditory stimulation and analyzes audiences' eye movement while reading the electronic magazine. The final objective is to give suggestions to the content organization and design of this kind of publications. From the perspective of readers' behaviors, this paper, by using eye tracking techniques, tries to analyze audiences' eye movement when reading e-magazine under visual and auditory stimulations.

Based on the theory described, the general hypotheses proposed, related to e-magazines reading, are as follows:

1) Fast-paced rhythm of the background music negatively affects reading efficiency.
2) Special visual effects have a positive effect on reading efficiency in terms of number of fixations.
3) Inserted pictures related to the text have a positive effect on the early recognition of its content.
4) Text dubbing has a positive effect on the processing time of the contents.
5) Visual stimulation and auditory stimulation have an integral impact on the comprehension of e-magazines' content.

3. Materials and methodology

3.1. Experimental materials

First, in order to know the most popular contents of Chinese digital magazines, we use the most popular Chinese digital magazines ranking (Zhongguoren Ranking) based on circulation and visibility conducted by Ruili, Shishangbasha and Yuedu (2014); we randomly choose three of them as a representative of e-magazines and we select their contents.

Second, an experimental e-magazine is created according to the content of the most popular Chinese electronic magazines. The selected content is short and easy to understand. It has eight short narrative and expository paragraphs, each paragraph around 600-700 Chinese words. The first one is about how to make pancakes; the second one is an introduction of roast lamb; the third one is a story about a soldier in the battlefield; the fourth one is a story about flood; the fifth is about a physicist's childhood; the sixth is an introduction of the development of water resources; the seventh is about the impact of microwave for people's health; the eighth is about the secret of Mona Lisa's smile.

The experimental apparatus used is Tobii T120 eye tracker, produced by Tobii Company. The hidden shape of this eye tracker will not cause obvious movement. This tracking device will not affect the tracking target, and will give larger space to the tracking target, so they can move freely, just like

sitting in front of the computer looking at the screen without any restrictions. Through this eye tracker, a long time experiment is possible, as it will not produce any fatigue. Tobii T120 eye tracker's frequency is 120Hz and the external screen resolution is 1280*1024. The eye tracker will automatically record eye movement data, the data for the first fixation duration, the total fixation duration and the gaze duration.

Finally, a multiple-choice-question-questionnaire that has 24 questions related to the content of the experimental e-magazine is designed. Each question has four answers but only one answer is correct.

3.2. The participant choice

According to China Internet Network Information Center (CINIC), in 2012, statistics showed that Internet users between 20 to 29 years old accounted for 29.8% of the whole Internet groups and the youth group is the main group that reads digital magazines. Therefore, 80 graduate students were randomly selected (40 males and 40 females): 40 students (20 males and 20 females) were involved in two pre-experiments and 40 students (20 males and 20 females) were involved in the experimental phase.

The experimental participants have next features: average age is 21 years old, normal vision or corrected visual acuity above 1.0; their mother language is Chinese and they have no eye diseases such as color blindness or color weakness. Out of the 40 initial participants, 31 finally took part in the experiment, 14 males and 17 females. Experimental mortality totaled 9 subjects (22.5% of the initial sample); the causes were the impossibility of obtaining 90% TOBII recording data.

The subjects came voluntarily to the laboratory where the experiment was held and they received a certificate for having taken part in the research. The procedures were performed with the informed consent of the subjects.

3.3. The experimental design

3.3.1. The experimental variables

The independent variables (IV) were five main variables related to the auditory and visual effects that could influence the process of reading and understanding the contents of electronic magazines. The independent variables (IV) are the next effects manipulated on the experimental e-magazine:

Variable A = background color (cool or warm).
Variable B = reading voice (without reading voice or with reading voice).
Variable C = rhythm of background music (fast or slow).
Variable D = special visual effects (with effects or without effects).
Variable E = inserted picture (related to the text or unrelated to the text).

According to the principle of Fine Arts, the background color was divided into cool colors (blue-violet) and warm colors (orange); the reading voice was recorded by broadcast professionals that read the text with normal speed; the background music choices were "Kiss The Rain" as fast rhythm and "Croatian Rhapsody" as slow; the falling of snow was chosen as the most widely used visual effects; the inserted pictures were divided into related to the text and unrelated to the text.

The dependent variables (DV) are the measurement of the effects of the electronic magazine in terms of the eye movements related with the reading efficiency and the reading comprehension of the text:

(1). Fixation count: it is the number of visual fixations during reading process. The length of the fixation count reflects the saccade distance and the reading efficiency in the sense that the decrease in the number of fixations implies more effective reading.

(2). First fixation duration: it refers to the time (in milliseconds) elapsed from the appearance of the picture until the first ocular fixation dispensed on this picture. It shows the readers early identification or recognition process.

(3). Gaze duration or fixation length: it is the length (in seconds) of the ocular fixations, which means the total fixation time before the fixation point falls onto another word (Zhang and Ye, 2006).

(4). Reading comprehension: it is measured as the percentage of correct answers of the comprehension questionnaire.

(5). Reading efficiency: it's measured as the number of fixations dispensed when reading text in all stimuli situations.

The controlled variable is the experimental e-magazine reading time: 60 seconds to all the participants (60 seconds is the average of the reading time obtained from the second pre-experiment).

3.3.2. Orthogonal design of the experiment

This experiment investigates five variables and for each variable there are two levels, so there are 32 different combinations (2 * 2 * 2 * 2 * 2 = 32), which means that 32 experimental situations are needed to be designed. In order to reduce the experimental situations, the orthogonal design as the experimental program is selected; this arranges the experiment according to the orthogonal table. It is a high-efficiency test design method used in multi-factor test to seek the best level combination. The number of experiments was reduced to 8. Table I shows the experimental program designed in accordance with the orthogonal experimental design method. In order to prevent the effect of the contents order on the answer's accuracy, the content of each stimulus is randomly arranged. Each stimulus is presented automatically in different screens during 60 seconds.

Table I. Orthogonal design of the experimental program

Stimuli (text content)	**Variables**				
	A1	**B1**	**C1**	**D1**	**E1**
1	A1	B1	C1	D1	E1
2	A1	B1	C2	D2	E2
3	A1	B2	C1	D2	E2
4	A1	B2	C2	D1	E1
5	A2	B1	C1	D1	E2
6	A2	B1	C2	D2	E1
7	A2	B2	C1	D2	E1
8	A2	B2	C2	D1	E2

Source: Authors

An experimental randomized block design (DBA) is performed. All participants undergo the same experimental situation (8 stimuli), but under different stimulus situation (variables).

3.4. Experimental procedure

3.4.1. Pre experiments

In order to select the best content of the e-magazine, a first pre-experiment about the content is done. In accordance with the specification of the experimental design, the interest of the contents is first measured. 20 subjects (10 males and 10 females) read 12 different contents about e-magazine topics and give score to its interest from one to five: the more the interest level increases, the higher the score. After this first pre-experiment, the readers' interest towards the content is balanced, so the two highest and the two lowest interest contents are deleted. The final content has the eight paragraphs (stimuli) about different e-magazine topics (see the material paragraph).

In order to measure the difficulty of the questions about the text, other 20 subjects (10 males and 10 females) do the second pre-experiment. Each subject reads the 8 paragraphs selected and answers 32 questions (4 questions for each paragraph). The questions that all subjects answered wrong and all answered correct are deleted; the 24 final questions left (3 questions for each paragraph) show a normal distribution with a moderate difficulty. Results of comprehension reading questionnaire are measured in accordance with the accuracy of the answer.

3.4.2. Experimental procedure

Experimental conditions included light adaptation (artificial and homogeneous light) and acoustic isolation. The experiment was carried out individually with each participant. The phases followed in the procedure were:

- Phase 1. Welcome participants and explain the research project and control. Participants were told that they were taking part in a research on e-magazine in which they would read different paragraphs and answer a brief questionnaire.
- Phase 2. Calibrating eye tracker. The calibration of recordings ensures that the subject's gaze is correct; that means that it will contain a minimum of 90% of the visual records.
- Phase 3: Presenting stimuli and recording the subject's visual behavior. After participants were validated for the experimental part, the stimuli were presented and the eye tracker data gathered. The subject was told "now you will have to read the content of the screen as if you were reading an e-magazine".
- Phase 4: After the experiment, each subject should complete the comprehension reading questionnaire.

4. Analysis and results

The results have been analyzed with the IBM SPSS program: Version 20.

First results do not show any differences between males and females. According to these results, next analysis will be done with all the participants without differentiating their gender.

To study the reading process of the e-magazine, the effects of the music rhythm, of the special visual effects, of the illustrations and of the reading voice on the results of the eye tracker data are analyzed. The study of the reading process includes the reading efficiency, the early recognition of the content and the study of the content processing.

The results of the effects of the background music (variable C) in the number of fixations (fixation count) are shown on Table II. As we can see, the average of fixation count when reading with the fast-paced background music (167.31) is similar to the one with the slow-paced background music (168.9) and ANOVA analysis of variance shows that there are no significant differences (p=.873) between the fixation times in both situations. These results mean that the speed of the rhythm of the background music has no significant effect on reading efficiency.

Table II. Average number of fixations in each situation (AVONA analysis)

Variables		N	Average	Standard D.	Sig. Level (P)
C: Music	**fast** **slow**	120 120	167.31 168.96	78.63 81.02	.873
D: Snow	**yes** **no**	120 120	172.33 163.94	78.19 81.24	.416

Source: Authors

The results of the effects of the visual effects (variable D) on the number of fixations (fixation count) are shown on Table III. According to Table II, while reading without special effects, the average fixation time is less (163.94) than reading with special effects (172.33) but ANOVA variance analysis show that this difference is not significant (p=.416). Therefore, the special effects that were originally used to enhance the visual effect of reading have no significant effect on its early recognition.

Table III. Average first fixation duration (milliseconds) under each kind of inserted picture (AVONA analysis)

Variable		N	Average	Standard D.	Sig Level (P)
D:Picture	**Related**	85	40.63	4.73	0.984
	Unrelated	78	40.77	5.21	

Source: Authors

The results of the effects of the kind of picture inserted in the text (variable E) on first fixation duration are shown on Table III. It can be seen that when the inserted picture is related to the text, the average first fixation (40.6 milliseconds) is similar to the one when the inserted picture is unrelated to the text (40,8 milliseconds) and ANOVA analysis of variance shows that this difference is not significant. Therefore, the content of the inserted picture has no significant effects on the average first fixation duration (p=.984).

The results of the effects of reading voice (variable B) on gaze duration (fixation length) are shown on Table IV. It can be seenthat when reading with reading voice, the average gazing duration (0.21 seconds) is less than the one of reading without text (0.30 seconds) and ANOVA variance analysis shows that this difference is significant (p=.05). That means reading voice has positive significant effect on the first fixation duration as the average gazing duration decreases in this situation.

Table IV. Average gaze duration (seconds) with and without reading voice (AVONA analysis)

Variable		N	Average	Standard D.	Sig. Level (P)
Reading voice	**yes** **no**	120 120	0.21 0.30	0.25 0.29	*.050

Source: Authors

4.1. Regression model analysis of the dissemination effects on the comprehension reading

To calculate the shared effect of auditory and visual effects on the comprehension level, the regression model is used. The variables are: background color (A), reading voice (B), rhythm of the background music (C), special visual effects (D) and inserted picture (E). In order to build a regression model about the comprehension rate (explained variable) and explanatory variables A, B, C, D and E, the corresponding dummy variables are:

(1) Dummy variables (Background color): X1 (1) = 1 refers to warm color, X1 (1) = 0 refers to cool color.

(2) Dummy variables (Text dubbing): X2 (1) = 1 refers to reading with text dubbing, X2 (1) = 0 refers to reading without text dubbing.

(3) Dummy variables (The rhythm of the background music): X3 (1) = 1 refers to slow, X3 (1) = 0 refers to fast.

(4) Dummy variables (Special effects): X4 = 1 refers to reading without special effects, X4 = 0 refers to reading with special effects.

(5) Dummy variable (Inserted picture): X5 = 1 refers to not related to the text, X5 = 0 refers to related to the text.

(6) Explained variable Y is the Comprehension rate (%).

According to the regression model, the equation is:

$$y = \beta_0 + \beta_1 x_1 + \beta_1 x_1 + \cdots + \beta_n x_n + \varepsilon,$$

ε is Random error.

The results of the regression model about the dissemination effects of the electronic magazine on the comprehension rate are in Table V. As we can see, there are two explanatory variables in this model (X2 and X1), which stand for text dubbing and background color, that have a significant effect (p=.000 and p=.008) on comprehension rate.

Table V. Regression model about the dissemination effects of the electronic magazine on comprehension rate

	Non-standardized coefficients		Standardized coefficients	t	Sig.
	B	Standard error			
(Constant)	44.079	3.312		13.309	**.000
X2	19.907	3.825	.311	5.205	**.000
X1	-10.220	3.825	-.160	-2.672	**.008

The gradual regression model has deleted the variables that have no significant effect. These are the rhythm of the background music X3(1), X3(2), special effects X4(1), X4(2), inserted picture X5(1), X5(2). The explanatory variables X2, X1 are highly significant. Thus the regression model about Y (Comprehension rate) and X2 (text dubbing), X1 (background color) is:

$$Y = 44.079+19.907*X2-10.220*X1$$

The regression model suggests that the text dubbing and the background color have a significant effect on comprehension rate. When the text dubbing X2=1, which means with text dubbing, a higher comprehension rate will occur; when the background color X1=0, which means with cool background colors, a higher comprehension rate will occur. Then comes the conclusion that with text dubbing and cool background colors, the dissemination effects of the electronic magazine are better.

5. Discussion and conclusions

Regarding the hypotheses proposed, we can conclude that the speed of the rhythm of the background music does not affect the reading efficiency in terms of number of fixations. These results ran in contrary to the findings of Chen, Sui, Wang and Qian (2008) that music led to decreasing the cognitive processing and reducing the processing speed. This might be due to the fact that reading is an automatic process and according to our previous results (Zhang and Añaños, 2014), also digital and paper reading are different in terms of heat map, and comprehension does not decrease in digital reading. Therefore reading efficiency will not be influenced by background music. Thus the first hypothesis is not met.

In relation to the second hypotheses, it can be concluded that the special visual effect does not affect the reading efficiency, so adding a variety of special effects in the electronic magazine will not affect people's reading efficiency. The same applies to the inclusion of illustrations in the text. Therefore,

while reading text-based e-magazine, the audience's interest will not change according to the content of the inserted picture, which means the inserted picture related to the text has no significant effect on the early recognition of the content. These results seem to contradict those obtained by other authors; however, it should be considered that the measure used in each study is different: in this study the effect of the picture on the duration of the first fixation is analyzed, while other authors study solution task (Han and Ren, 2003), pupil size (Ding, Wang and Zhang, 2005) or the number of fixations (Añaños and Astals, 2013). The second and the third hypothesis are therefore not met.

In relation to the effect of text dubbing, we can conclude that reading voice has a significant effect on the average gaze duration, as means on the processing time of the contents. Adding text dubbing to the e-magazine makes the reader follow the rhythm of the voice to read. When reading with the text dubbing, people will subconsciously follow the dubbing while reading, accompanied by reading and gazing time will change according to the dubbing speed. But the reading speed may vary differently among each person. So reading with text dubbing can increase the gazing time and influence the reader's reading. These results contradict those obtained by Xu (2011) who found that text and graphics have, together, more positive results than those obtained by text with graphics and with text dubbing. Why? Maybe owing to the fact that our data have not analyzed the effects of text dubbing together with text and graphics. The fourth hypothesis proposed is therefore fulfilled.

Finally, it can be concluded that text dubbing and background colors have a significant effect on reading comprehension, so with text dubbing, the accuracy rate is higher. The accuracy rate is also higher with cool background colors. In conclusion, the dissemination effects of the electronic magazine are better with text dubbing and cool background colors, which means that visual stimulation and auditory stimulation have an integrated impact on e-magazines reading.

Finally, according to Rovira, Capdevila and Marcos (2014), generalizing the findings to the general population would require additional studies that confirmed the results in other languages and in other cultures.

Also, we consider that some of the differences between studies with eye tracker are due to the measure used to analyze the reading efficiency from the results of eye movement that occurs, and also to the kind of experimental tasks. Definitely, science and research are not saved from media excesses (Martínez-Salanova, 2013); however, the visual process of digital and paper reading is different in terms of visual attention, but digital reading does not lead to shallow reading (Zhang and Añaños, 2014).

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