The Impact of White Space on User Experience for Tablet Editions of Magazines

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Abstract

As magazine publishing emerges into the digital world, it needs to achieve the degree of readers' desire that is comparable to or surpassing print publications. As a result, designers and publishers for digital magazines must create well-designed magazines that attract more readers.

We are moving into the digital arena, which is a new revolution for transferring the design from the printing platform to the digital platform. Essentially, the manifold technologies, operating systems, screen sizes, and resolutions impose the concern for publishers seeking a reference. Therefore, it is necessary to develop a guideline for designing digital magazines which will help magazine publishing industry to achieve scale and profitability. In this paper, the researchers focused on one of the design elements: white space. The aim of the present study is to investigate how user experience is affected by white space in the layout of digital editions of food magazines designed for a tablet, such as an iPad. The food magazines were chosen because the life style magazines, and specifically the food magazine category, is the fastest growing genre for digital magazine publishing (Bazilian, 2013).

Background

The magazine industry in the United States has experienced significant changes in recent years. With the proliferation of smartphones and the Internet, consumers make fewer trips to the newsstand (Sasseen, Matsa, & Mitchell, 2013). According to Statista.com, digital magazine readers in US grew to 27.2 million in 2017, compared, for example, to the 16.9 million in 2013, which was reported in the MPA FACTBOOK 2013-2014 (2014). This number is projected to increase by 55% in 2022, and the prediction for further increases is favorable.

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Therefore, more and more publications are meeting this challenge by distributing their content via up-to-the minute digital platforms that include websites, smartphones, and tablets. The growing popularity of magazines' digital editions increases the demands on the publishers to provide superior design and user experience to satisfy readers' preferences.

In order to understand preferences for digital magazine design patterns, we decided to focus on the white space as a design factor. The basic definition of white space was chosen after Pracejus, Olsen & O'Guinn (2006) as the conspicuously open space between other design elements or objects within the borders of a graphic communication instance, for example, a page of a document or an advertisement. White space usually encompasses margins, gutters, leading, etc. It is named this because of the typical background material of its day, but the white space is not necessarily white. The study utilized an user experience framework to evaluate the impact of white space on the digital magazines with readers. The user experience is defined as "a person's perceptions and responses resulting from the use and/ or anticipated use of a product, system or service" (ISO/FDIS 9241 -21). Measuring user experience can quantify the readers' response regarding digital magazines, and consequently, help to improve the design for digital editions. In the study the participants interacted with the digital magazine on an iPad and reported their perception and responses regarding their interaction.

Methodology

To assess the white space for the purpose of this research, the well-known "figure-ground" relationship is adopted, specifically, the stable figure-ground relationship (White, 2011), where all the elements on the page are shaped into fixed frames (Figure 1). As seen in Figure 1, all the framed content represented by the blackened rectangles is considered as the figure, and the space between the rectangles serves as the ground.

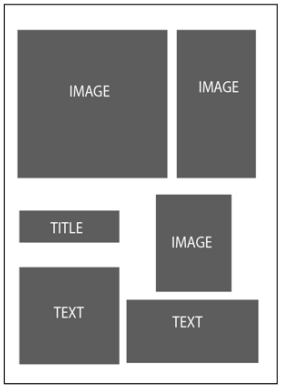


Figure 1. *The example of "figure-ground" relationship. The black boxes are the figure and the white area surrounding is the ground.*

In order to manipulate white space easily, the white space is separated into macro and micro white space. Macro white space is the space between major elements in a composition. The shadow area in Figure 2 represents the macro white space.

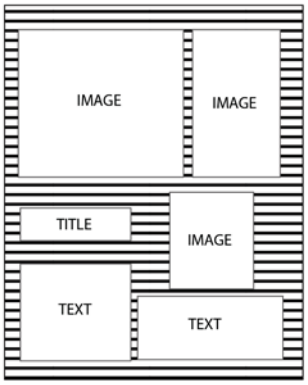


Figure 2. *The macro white space is designated by the shadow area.*

The micro white space is the interline space, which is defined as the space between the baseline, underlying the line of text, and the x-line of the line below as shown in Figure 3.

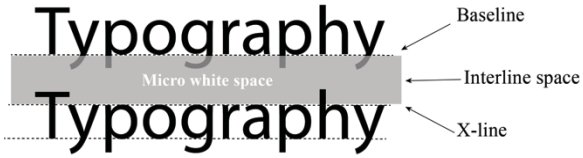


Figure 3. *The micro white space is shown as the gray area. The micro white space corresponds to the interline space.*

By separating macro and micro white space the white space elements can be quantified and manipulated to obtain varying white space levels for the study. For the user experience (UX) evaluation three perspectives (dimensions) were chosen: visual aesthetics ("satisfaction"), perceived readability ("usefulness") and perceived legibility ("ease of use").

We addressed the following research questions: 1. For articles in the digital editions of food magazines on an iPad platform, does white space influence the UX (visual aesthetics, readability and legibility) for the readers? 2. If so, which dimensions of UX have been significantly affected by white space? 3. Are there any exact quantitative features in terms of white space that can help designers understand and select preferred design patterns for digital magazines?

In the study design, therefore, we included independent variables: macro and micro white space, and dependent variables: measures of visual aesthetics, readability and legibility.

The experimental study was implemented in three steps: 1) preliminary test, followed by 2) defining and preparing the main experiment, and 3) conducting the main experiment.

The preliminary test was to screen out the stimuli for selecting one reference page for the main experiment. The second aim of the preliminary study was to estimate the effect size, which was used to determine how many participants were needed for the main experiment. During this step, 27 magazine pages with different layouts and content were shown to 10 participants and their ratings along the three UX dimensions were obtained. Additionally, we asked participants to rate their preferences for the content of the page, including the food in the recipe. We purported to identify a typical page that produced rather neutral responses, with the ratings in the middle of the scales, to avoid any food preferences and also give us room for variation. As a result of the preliminary experiment, one page with two-column structure was selected. The content was chosen as a recipe of savory food. The macro white space for the reference page was calculated using the threshold and histogram options in Adobe Photoshop. Based on the calculations, the content area for the reference page was 69%, while the macro white space of the reference page equaled to 31%.

After choosing the reference magazine page, the levels of macro and micro white space were varied in the following manner. By adding 7% to each consecutive level starting from the reference, 31% macro white space, five levels of macro white space were defined. They were: 31%, 38%, 45%, 52%, 59%. The manipulation of macro white space was done through calculations using Microsoft Excel. We measured the width and the height of all the blocks on the reference page. The height and the width of each block were then changed in accordance with the selected levels for the independent variable of macro white space. Specifically, the height and the width of the blocks were changed in proportion to the ratio between the target macro white space and the reference macro white space. The goal was to manipulate the white space evenly, not to affect the whole design of the page. Based on the estimation of the effect size we determined that we needed at least 60 participants for the main experiment.

To manipulate the micro white space, the changes were made in the “leading” in Adobe InDesign. As the starting point, we used the default auto-leading option of 120% of the type size, because 120% is considered to be the optimal point. Two additional levels of micro white that deviated from 120% by 15% were added. This resulted in three different levels of micro white space: 105%, 120% and 135%. The 105% of type size was the same as the line space setting in the reference magazine page. In total, we produced 15 experimental stimuli with different combinations of the macro and micro white space: 5 macro levels * 3 micro levels. Figure 4 shows the reference magazine page.

Figure 4. *The reference magazine page with 31% macro white space and 105% micro white space.*

The main experiment consisted of two parts. In the first part we obtained the self-report measures of user experience along the three scales constructed as seven-point interval scales with anchored end points. Participants rated their impressions of the visual aesthetics, legibility and readability in response to three questions: How satisfied are you with the visual aesthetics of this page? How legible do you find this page? How readable do you find this page? Participants were asked to rate each page on the scale from one to seven points, from "Not at all" to "Extremely." The definitions for visual aesthetics, legibility and readability were provided as follows. Visual aesthetics is the degree of how harmonious or beautiful the design appears to a person. Readability is the degree to which a body of text is easy for people to read and understand. Legibility is the ease of how characters and words can be distinguished by eyes.

In the second part we assessed legibility and readability using the objective measures. For the legibility, the letter counting task was adopted. Each participant was requested to read two paragraphs with different white space levels and count the total number of specific letters in the text. The completion time and the count were recorded. Two legibility measures were constructed: 1. The Average time that participants spent on distinguishing each letter calculated as the time the participant used to count the designated letter divided by the total number of letters in the paragraph; and 2. The percent of correct responses estimated as the percentage of the number of letters the participant counted compared to the actual number of the specified letters.

To assess the readability, the participants were told to recall the ingredients' names after they read the ingredients paragraph. The numbers of ingredients they recalled were recorded. The percentage of correct responses, which is the proportion of the ingredients participants recalled compared to the total number of ingredients in the paragraph, was documented.

Sixty-two female RIT students between 18 to 28 years old in RIT participated in the experiment. They had normal color vision and visual acuity. The participant cohort was chosen because according to the Food Network Magazine Media Kit female readers in the Food Network audience amount to 71.6 %. 59.2% of the readers are in college.

Results

The two-way repeated measures Analysis of Variance (ANOVA) was applied to test the significance of the independent white space variables, namely the main effects of macro and micro white space, and the interaction effect between macro and micro white space variables. The participants were considered as a random effect. F ratio is the statistical measure to test null hypothesis. P-value of 0.05 was used as a cutoff value to designate statistical significance. Least square means were employed to point preferred white space combinations. Least square means are the estimated group means using the analysis procedure.

The fixed main effects for macro and micro white space and fixed interaction effect between macro and micro white space were evaluated for Visual Aesthetics. As seen from Table 1, all three fixed effects were statistically significant with the P values less than 0.05. This result demonstrated that the macro and micro white space had highly significant influence on participants' impressions of visual aesthetics. The interaction effect between macro and micro white space levels was also statistically significant.

Source	F Ratio	Prob > F
Macro	3.14	0.0141
Micro	11.90	<.0001
Macro*Micro	3.13	0.0017

Table 1. *Fixed effects test for visual aesthetics ratings*

The least square means estimates for this experiment shows that 38% macro white space with 135% micro white space has the highest value, which is 5.87 (Figure 5).

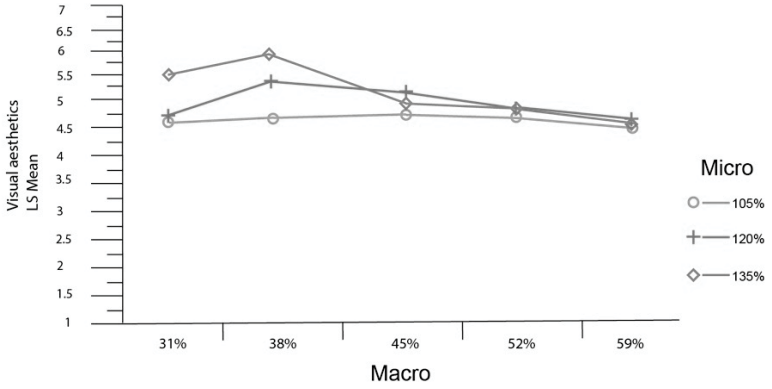


Figure 5. *The least square plot for visual aesthetics for the interaction between macro white space and micro white space.*

As seen from Table 2 for the perceived legibility results, all three fixed effects were statistically significant, showing that both macro and micro white space had significant influence on participants' impressions of legibility, similarly to the visual aesthetics. The interaction effect between macro and micro white space variables was also statistically significant.

Source	F Ratio	Prob > F
Macro	4.76	0.0008
Micro	28.76	<.0001
Macro*Micro	3.08	0.0020

Table 2. *Fixed effects test for legibility ratings*

According to the least square means estimate, the 38% macro white space with the 135% micro white space page has the highest response of 5.75 (Figure 6). This can be interpreted that the majority of the participants thought that this magazine page was more legible compared to the rest of 14 samples of white space combinations. This result is identical with the result on visual aesthetics.

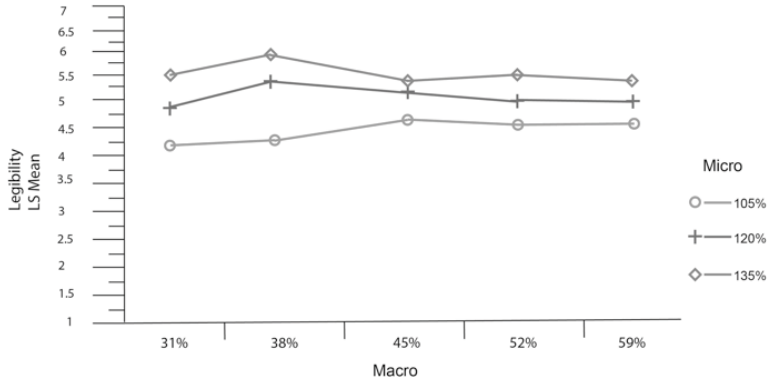


Figure 6. *The least square plot for legibility ratings for the interaction between macro white space and micro white space.*

The results for the readability ratings were similar to both, visual aesthetics and legibility. As seen from Table 3, all three fixed effects are statistically significant.

Source	F Ratio	Prob > F
Macro	3.96	0.0008
Micro	8.57	<.0001
Macro*Micro	2.33	0.0020

Table 3. *Fixed effects test for readability ratings*

Similar with the previous results, the 38% macro white space -135% micro white space combination has the highest estimate (Figure 7), which can be interpreted that this design was perceived as the most readable by the majority of the participants.

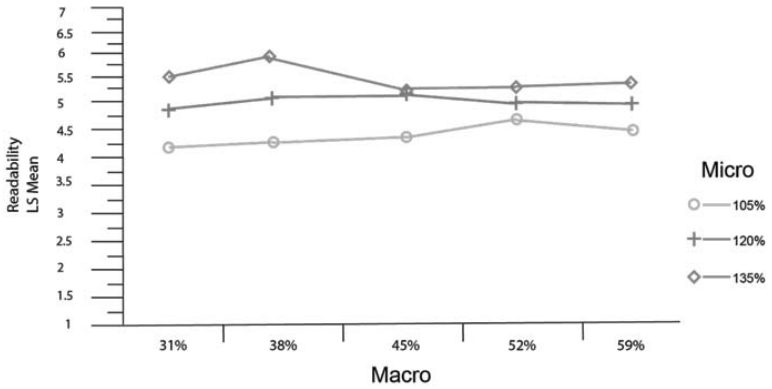
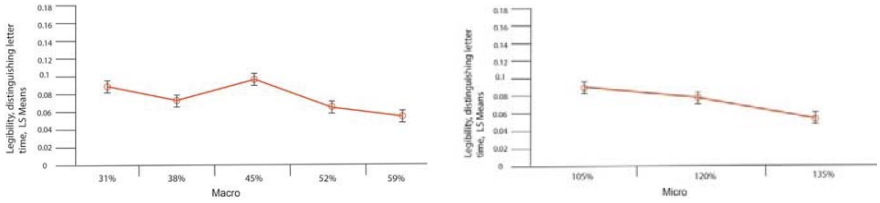


Figure 7. *The least square plot for readability ratings for the interaction between macro white space and micro white space.*

The statistical data analysis for the second part of the main experiment was conducted to observe the relationship between the white space and the objective measures for legibility in the letter counting task and readability in the ingredients recall task.

The results showed that the main effects of macro and micro white space and the macro-micro interaction effect on the legibility in terms of the time participants spent on distinguishing each letter were highly significant. The participants took more time to search for letters when the macro white space was smaller: the longest time was spent on distinguishing letters for 31% macro white space, while the shortest time was for the 59% macro white space (Figure 8a). Similar relationship was observed for the micro white space: the higher the micro white space, the less time was spent on distinguishing letters (Figure 8b).



a) ***b)***

Figure 8 (a,b). *The least square plot for time-based legibility measure: a) for macro white space; b) for micro white space.*

When different macro-micro white space combinations were compared, the 52% macro white space with 135% micro white space was the easiest design for participants to distinguish each letter in the paragraphs. At the same time, they spent the longest average time per letter on the reference page with the 31% macro white space and 105% micro white space.

For the second legibility measure calculated as the percent of correctly counted letters, only the micro white space and the micro-macro white space interaction were significant, while macro white space had no influence on this measure, as can be seen from Table 4.

Source	F Ratio	Prob > F
Macro	1.20	0.3153
Micro	3.16	0.0472
Macro*Micro	3.75	0.0008

Table 4. *Fixed effects test for legibility, the percent of correct counts.*

The least square mean plot for this measure showed that with the increase of micro white space (Figure 9), the correct percentage of letter counting increased. 135% micro white space had the highest least square mean for the percent correct. It was the lowest when the micro white space was 105%.

Interestingly, for the interaction effect when both macro and micro white space factors were considered, the highest percent of correct responses happened for the 135% micro -31% macro white space and for the 120% micro - 59% macro white space combinations. However, for the combination when the micro and macro white space levels were the largest as for the 135% micro and 59% macro white space, the lowest result was observed (Figure 10). This indicates that too much spacing adversely affects the performance of finding letters.

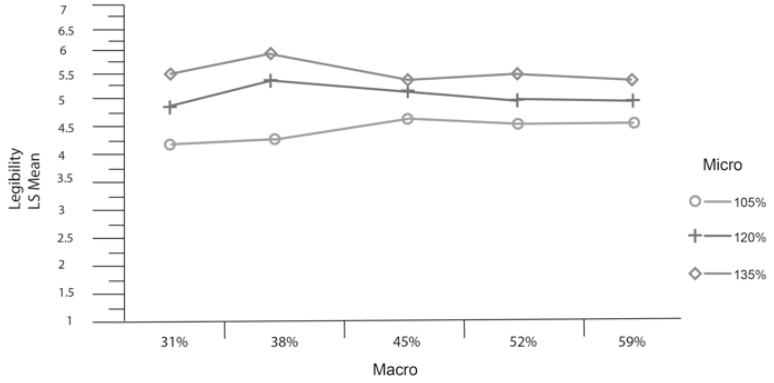


Figure 9. *The least square plot of percent of correct letter counts for micro white space.*

The results for the readability in the ingredients recall task calculated as the percent of correctly remembered ingredients are shown in Table 5 and Figure 11.

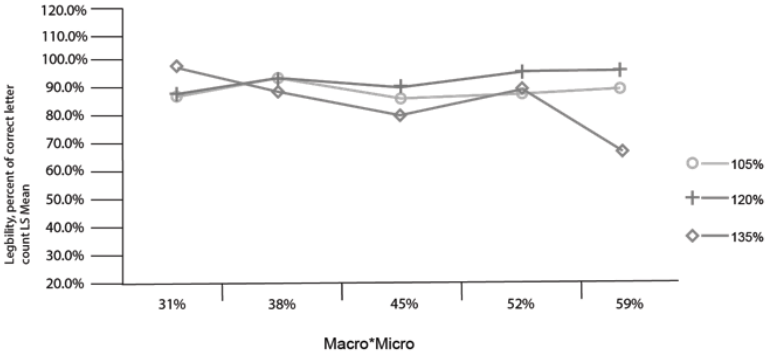


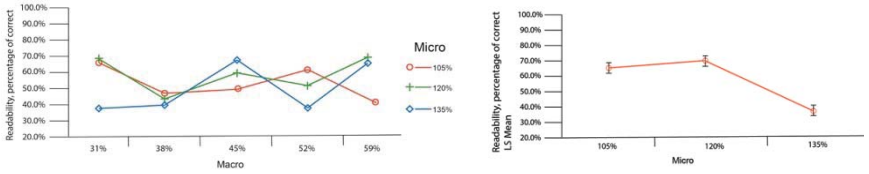
Figure 10. *The least square plot of percent of correct letter counts for the interaction of macro and micro white space.*

From the effects test table (Table 5), all the fixed effects were significant for this readability measure, including the main effects of macro and micro white space and the interaction effect.

Source	F Ratio	Prob > F
Macro	3.65	0.0095
Micro	14.53	<0.0001
Macro*Micro	6.64	<0.0001

Table 5. *Fixed effects test for readability, the percent of correct recall.*

From the least square mean plot for macro and micro white space, an irregular curve can be observed (Figure 11 a). It is difficult to find a combination that was clearly better in terms of the performance or identify a systematic trend. However, when the influence of the micro white space is evaluated in isolation (Figure 11 b), the 120% micro white space was significantly better that the 135% micro white space level and slightly better than the 31% level in terms of the percent of correct recall. This found discrepancy compared to the micro white space effects on the perceived readability results (Figure 12), may be related to people's reading habits and capability of memorizing when the text lines are spaced more than the widely used interline space of 120% of type size, set as the default value for the layout leading settings in Adobe InDesign.



a) ***b)***

Figure 11. *The least square plot of percent of correct ingredients recall as the readability measure for the interaction of macro and micro white space (a); for the micro white space only (b). The highest percent of correct recall occurs when the micro white space is 120%. The percent of correctly recalled items dropped quickly when the micro white space increased to 135%.*

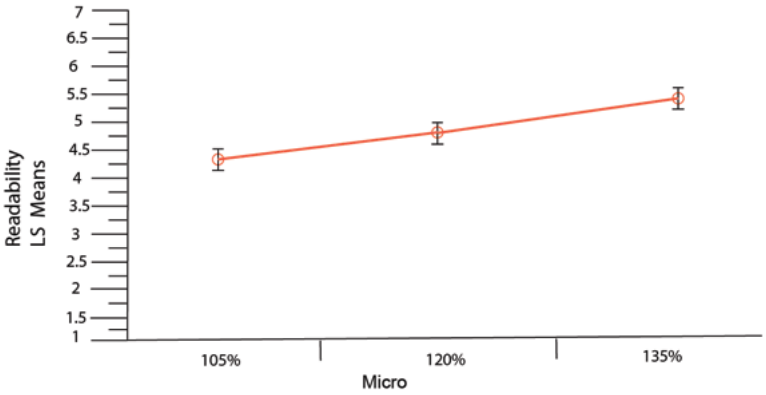


Figure 12. *The least square plot of perceived readability ratings for the micro white space. The perceived readability monotonously increased with the increase of the micro white space, counter to the results of Figure 11 b).*

Summary and Conclusion

Based on the results of user experience evaluation the effects of the white space: macro, micro and interaction of macro and micro white space had significant impact on all three attributes of user experience: visual aesthetics, perceived readability and perceived legibility. The ratings data demonstrated that the majority of 62 participants chose the 38% macro white space, and 135% micro white space to be the best combination regarding all three aspects of user experience. Also, from the results of the second part of the experiment which employed letter counting and recall tasks, only the macro white space did not have significant effect on the percent of correct for letter counting legibility assessment. For the readability, all three effects were significant.

The purpose of this study was to develop a guideline to help designers to manipulate white space for digital magazine publications. The above findings outlined three main results that designers might refer to for different concerns. First, the 38% macro white space with 135% leading setting option is the best choice regarding perceived visual aesthetics, perceived legibility and perceived readability. What is more, the results from the second part of the experiment showed that people spent the least amount of time on searching letters when the primary macro white space was 59% and the micro white space was 135%. For the percent of correct regarding the legibility, the design with 135% micro white space had the most positive effect. As a result, if designers want to achieve high legibility of a magazine page, they should consider leaving high macro white space, which is more than 50% space of the magazine page on the iPad and high micro white space that is higher than the default line space in the Adobe InDesign software. For the perspective of readability, the results were similar to the legibility. It was concluded that for the combination of macro white and micro white space, the perceived readability increased when the macro white space was larger than 38% and 52%; the micro white space was 120% or 135%.

There were some discrepancies between the results of the questionnaire and the objective observation in the form of recall. The researchers suggested that that was related to the participants' reading habits and capability of memorizing, potentially associated with the use of 120% interline white space in the design software. The discrepancies notwithstanding, it is our belief that designers could refer to the results described in this paper for different purposes.

Acknowledgments

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