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Abstract. This paper presents results from a study on the effectiveness of digital signage in the retail environment. The goal of the study was to examine design parameters relevant to digital signage content design which could be used to create guidelines and templates for designing effective digital signage content. In this study, we focused on how video and animation affect the effectiveness of digital signage. When comparing still content with content enhanced with video or animation, no significant difference in effectiveness could be observed. This observation contradicts with earlier studies. Our study supports the views that the digital displays are currently most useful and effective to the younger generation, and that male customers consider digital displays in a store more useful than females do.

Keywords: Digital signage, User study, Retail store, Media management, Digital content design, User interfaces, User experience.

1 Introduction

Digital signs or displays are currently used widely for delivering information in public spaces. Both in- and outdoors, they are ubiquitous in transportation systems, sport stadiums, shopping centers, health care centers and stores. Among other things, digital signage is used for advertising, information sharing and entertainment purposes. The underlying goals of such signage are to provide better service for customers and promote sales. From a retail perspective, digital signage can be seen as one of the many channels that aim to capture people's attention and affect their customer behavior. Digital signage provides retail actors with a channel where content can be updated rapidly and with ease [5]. It can also provide retail actors a communication channel which is entirely in their control, creating opportunities not available with traditional media.

The study presented in this paper examines how effectively customers perceive various visual contents on digital displays in retail stores. We examine if the effectiveness of digital display content in retail context can be improved with video or

animation, and if there is a difference between genders and age groups on the perceived usefulness and effectiveness of digital signage. We also examine how content design for digital signage could be supported by visual design templates that partially automate and unify the content design process. Ultimately, our goal is to understand the interplay between digital signage technology and digital advertisement content, and how they can be combined to achieve the desired impact on retail consumer choices.

The motivation to our study comes from the participating retail company. The company has made a strategic decision to move more of its advertisement content from traditional, external advertisement media, such as newspaper, radio and television, to digital media platforms which are in their direct, real-time control. These platforms include digital signage placed in the company's retail premises, and social media. This change has effects in the operation and management of their advertisement department. The new digital channels provide improved possibilities for real-time content updates and content localization. However, utilizing these possibilities requires new skills, design approaches and content management procedures, as well as thorough understanding of the new platforms.

Our study was executed in two parts. First, we conducted a literature survey on previous digital signage research. Based on our findings, we then executed a field study where we created and delivered digital content to the displays in retail stores of a co-operative retail chain located in Northern Finland and evaluated the effectiveness of different content designs. We used the number of customers who remembered the fact(s) shown on digital displays as a measure for effectiveness.

2 Related Work

Previous studies, such as Huang et al. [4] and Höffler and Leutner [3], show that the format of the digital content affects the effectiveness of digital displays. People find video content more attractive and it captures the eye longer than text or still images [4]. In addition, video-based animations seem to be superior to computer-based animations [3], as video content captures the eye somewhat longer [4].

Similarly to banner blindness on web sites, which has been discussed, for example, by Nielsen [9], most public displays are ignored by many people or receive only very few glances [4]. Thus, the process of selective attention also applies to digital signage, an effect known as 'display blindness' [7]. People expect uninteresting content, which leads to a tendency to ignore the displays. In a study conducted by Müller et al. [7], colorfulness was the most important factor influencing whether people thought they would look at the displays.

Shoppers are most responsive to localized information, such as information on new items, promotions and seasonal information, as well as messages about hedonic products, such as food and entertainment [1]. Additionally, shoppers are most interested in messages that address the task at hand and their current need state [1]. According to [10], males are more attracted and receptive to digital signage than females.

3 Research Methods

3.1 Study Setup

The pilot study was set up in four different stores in the city of Oulu, Finland. The study duration was two weeks. Three of the stores were local grocery stores and one was a supermarket. Digital content was shown to customers in three of the stores. The fourth grocery store did not have digital displays and we used it as a reference case. Content design was a collaborative effort between retail experts, digital signage experts and researchers. For the study, we created three content themes which were identified by the retail chain to be representative examples of advertisement content they would like to communicate through this media channel: 1) *Energy savings*, 2) *Local food*, and 3) *Familiarity with the store manager* (Table 1). For each theme, we presented the same content using four different types of templates:

A *Still picture*: nothing was animated (Figure 1);
B *Background animation*: there was some animated movement in the content background to draw the customers' attention (Figure 2a);
C *Fact animation*: animated movement was added to the key fact in the conveyed message (Figure 2b);
D *Narrative animation*: a sequence of animations was used to draw attention to different parts of the message in a desired order.

The abovementioned content themes were presented on the store displays by using one type of content template at a time. In other words, during one pilot study day the themes were shown to a specific store's customers using only A, B, C, or D from the list above. We collected data through customer interviews about the impact that each template had on the store customer. We created the above-mentioned templates partially based on the findings on visual efficiency from related digital signage research but also due to our study goal of experimenting with content formats that could potentially be used as templates to help marketers create new digital content.

Several planning sessions between retail experts, digital signage experts, a media designer and researchers were conducted in order to create an appropriate set of questions for customer interviews in stores. The question set was kept short as customers are often quite busy while grocery shopping. In addition, a public space is not the best possible place for long interviews.

Table 1. Study setup in each store.

Store	# of interviews	# of displays	Content themes on displays
Grocery 1	122	2	Energy, local food & store manager
Grocery 2	142	1	Energy, local food & store manager
Grocery 3	43	0	No content (For Reference)
Supermarket	244	8	Energy, local food
Total	**551**	**11**	

Fig. 1. An example of display content. The template is Still picture: nothing is animated. The content theme is 1) Energy savings. The text says: 'We are saving energy in this store - up to 50% - using new energy solutions'.

Fig. 2a&b. Examples of display content. In Fig. 2a the template is Background animation: the branches and leaves grow in the background. The content theme is 2) Local food. The text says 'Best food is local – Rönkä's products now in our store – Follow this sign > Local product'. In Fig. 2b the template is Fact animation: the text "Tervetuloa omaan kauppaan!"(i.e. Welcome to your own store!) appears when the store manager turns and points to her upper right. She also briefly looks further down at her name "Sari". The content theme is 3) Familiarity with the store manager. The text says 'Welcome to your own store! – Wishes Sari, the store manager'.

All digital displays utilized in the pilot were located indoors. In the grocery stores the displays were typically located quite close to a cash desk. In the supermarket they were located along the corridors. The displays were located quite high with the exception of one small display that was located on a lower level nearby a cash desk that was used only during the peak hours. All displays had rather large screens (about 50 inches), excluding the small display mentioned above.

3.2 Study Execution

The customer interviews in stores were conducted during the stores' opening hours between noon and 5 PM. The length of each interview was from five to ten minutes. The interviewers asked the customers to answer the survey questions when they were leaving the store, i.e. after being exposed to the store's digital display(s). The total number of interviews was 551. Of the interviewees, 278 (50.5%) were females and 273 (49.5%) were males.

Table 1 also presents the content themes used in each store. Questions related to the familiarity of the store manager were not asked in the supermarket since the man-

ager is not meant to be as visible to the customer in the supermarket as s/he is in the grocery stores. Tablet computers were used by the researchers during the interviews to record and store the answers. Afterwards, the answers were exported to an Excel sheet and analyzed with Excel's analysis tools.

4 Key Results and Findings

Our main goal was to collect data through customer interviews about the impact that each content template had on the store customer. Our data shows that none of the templates was very effective, i.e. the majority of the customers did not pay much or any attention to the displays regardless of the template used. This is illustrated by reoccurring customer comments such as *"Where are the digital displays in this store?"* There were 551 respondents in our study. Our results show that there was no statistically significant difference (p-value less than 0.05) on the effectiveness of the displays presenting content with or without video or animation. This is contradictory to the findings of Huang et al. [4] and Höffler and Leutner [3].

Data from our study supports the view that the digital displays are most useful to or perhaps best exploited by the younger generations. Respondents that were under 45 years old knew the displayed fact on energy saving and recognized the store manager clearly more often than the older respondents (Figure 3). 4-6% of the participants that were under 45 years old learned the fact about energy saving from the info displays, whereas only 1–2% of the participants that were 45 years or older learned this fact.

The respondents' own views were in accordance with our abovementioned observation that digital signage is most useful to the younger generations. To find out about the perceived usefulness of digital displays in the store, the interviewees were asked to evaluate the statement 'I find digital displays in the store useful'. A 5-point Likert scale (1 = Strongly agree, 5 = Strongly disagree) was used to determine the customers' subjective conception. When comparing responses between younger (under 45 years old) and older respondents (over 45 years old) we can see that the younger generation considers digital displays located in a store more beneficial (Figure 4a). Six responses without age information were excluded from the analysis. The findings discussed above indicate that digital signage, although currently vastly ignored by the customers, may become an increasingly efficient form of media in the future as digital literacy increases generation after generation.

According to our research data, males considered digital displays in a store slightly more useful than females (Figure 4b). 41% of male and 35% of female respondents selected either 'Strongly agree' or 'Somewhat agree' in response to the statement 'Digital displays are useful for me in the store'. 44% of males and 52% of females disagreed somewhat or strongly with this statement. Ravnik and Solina's [10] research also supports the observation that males are more attracted and receptive to digital signage than females.

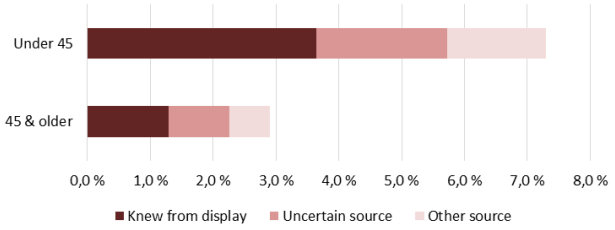

Fig. 3. Age distribution of respondents who knew the fact about energy management.

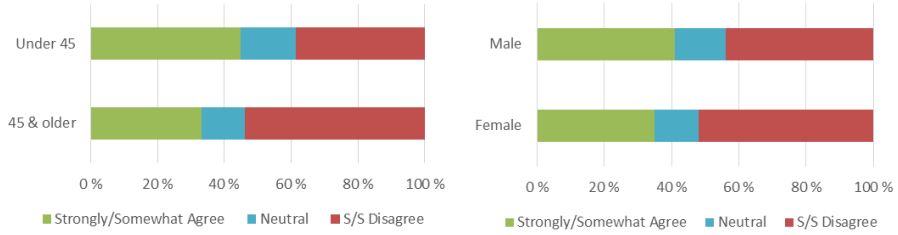

Fig. 4a&b. Fig. 4a shows age preference in relation to 'I find digital displays in the store useful', and Fig. 4b) Gender preference in relation to 'I find digital displays in the store useful'.

5 Considerations on Data Validity and Interpretation

Our research method was strongly based on whether the interviewee knew the fact presented through the digital display or not. In the case of a correct answer, we asked where the interviewee thought he or she had learned the fact in question. However, the correctness of their answers is subject to interpretation. As an example, we consider the question about how much energy the store had saved. 14 out of 192 (i.e. 7.3%) respondents that were under 45 years old knew the correct answer. Half of them said they got the information from the digital display and an additional four were uncertain of where they got the information ('cannot say', 'a guess' or 'saw it somewhere'). Three respondents clearly named a different source. Thus, we obtained the result that 4–6% (i.e. 7-11/192) of the participants under 45 years old learned the fact from the displays in the store. However, it is difficult to evaluate how reliably people can recall in an interview situation from which source they learned certain facts.

A high percentage (39%) of the respondents identified the store manager from the picture shown to them, and 4.5% knew the manager's name. Younger customers knew the manager's name more often than older customers. However, it is likely that there is distortion in this data due to the fact that many customers already knew or were somewhat familiar with the store manager, which appears to be a quite common situation in smaller grocery stores. Indeed, many of the respondents reported that they

identified the store manager from the picture since they had seen the manager in the store. As the energy policy of a particular store was not at all as visible to the customers as was the store manager, we consider energy savings to better indicate how well the customers learned the fact from the display.

6 Discussion and Future Work

Our results indicate that many users did not pay attention to digital displays or ignored them altogether. The content format did not have a statistically significant effect on effectiveness, i.e. it was equally low with still, animated and video based templates that we used.

Although the percentages of the correct responses regarding the content of the digital displays may seem small, they are roughly tenfold in comparison to the average click-through-rates (CTR) in display advertisement (i.e. 0.1–0.3% according to Chaffey [2] and Stern [11]). Also, cost per impression (CPI) in digital displays can be very low if the displays are owned and run by the retail actor, and digital content can be easily and rapidly updated. This can create communication possibilities, for example, for real-time advertisement where the storage situation, weather conditions or other contextual data is used for automated content generation.

The reason for the low percentages might be that the content of pilot displays was conservative in nature. The effectiveness of in-store advertising largely depends on the content of the message; shoppers are most responsive to messages that relate to the task at hand and their current need state [1]. There are several means that might help us improve the effects of digital displays in the retail environment. Our data indicates that animation alone is not enough. In the future, we should extend our study to test stronger manipulations of message content and format. For example, stronger colors, contrasts and the use of audio could possibly attract the attention of store customers more effectively. In addition, the use of interactive elements could capture the customers' attention better. One future development idea would be also to enhance digital display systems with people tracking, e.g. by using depth sensors [6]. For example, the distance, amount, size and direction of the customers can be tracked and utilized when showing the changing content on the display.

Based on our results, it seems that younger generations see digital displays as being more beneficial in the retail environment than the older generations. A natural reason for this might be that younger people are used to collecting and utilizing digital information from a wide array of digital sources. Some terms and concepts from the digital era may also be unfamiliar to senior citizens. For example, our pilot study interviews revealed that it was not perfectly clear for some senior citizens what digital displays are; as a result, they were not prepared to pay attention to digital in-store information. Instead, older store customers largely reported that they still mostly utilize the 'traditional' media sources of advertising and communications, such as local newspapers and ad signs placed outdoors in front of the stores.

Behavioral measures of signage effectiveness such as shopper attention, product interest, and sales should be included in a future study. Furthermore, in the next phas-

es of the research the effect of the physical positioning of displays in the store could be studied in more detail. Although we did not include questions related to display size or positioning, the topic came up spontaneously in various occasions. In our study all of the digital displays (except for one small display) were located relatively high in the store. Eight respondents proposed that they would be easier to see if they were on a lower level. The manager of the store where the small display was located had observed that the display was very popular among the customers. Huang et al. [4] claim that small displays may encourage or invite prolonged viewing in public spaces to a greater extent than large displays. However, without further study we cannot say whether the customer preference for this display in our study was due to the small display size or, for example, the positioning of the display near the cash register queue, as suggested by some of our respondents. Positioning the display at eye-level has been found to be far more effective at attracting glances [4], and people prefer digital signage that is located where they could pause or wait [8]. The degree of engagement seems to vary depending on the shopper's angle of approach and proximity to the display screen [4]. We aim to address display size and positioning, as well as other issues discussed above, in our future work.

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