Modeling the Impact of Visual Components on Verbal Communication in Online Advertising

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Abstract. Together with the development of electronic marketing, the key factors that influence the effectiveness of interactive media were identified in the earlier research. This article presents approach which makes possible to determine the relationship between the textual and visual components and their impact on results of the campaign. The structure of interactive advertising unit with adjustable visual and verbal influence is presented followed by results from the field experiment performed with the usage of proposed approach.

Keywords: Online advertising · Human-computer interaction · Web design

1 Introduction

The growing importance of digital marketing influences the need for environmental studies of the interactive phenomena that occur in online marketing. Research in this area is focused mainly on increasing the effectiveness of advertising campaigns, modelling their impact on audience and analyzing the effects [9]. The basis of many solutions in this area is marketing engineering, which develops in conjunction with computer science and data processing algorithms the analytical systems towards adaptive solutions [13]. There is also integration of knowledge from fields such as sociology, psychology and social engineering and connecting them with analysis of user experience and different methods of website evaluation [16]. The areas of research in this field relate to modelling levels of perception and interaction with the impact of the marketing message on the recipient. Phenomenon's such as habituation or sensory adaptation, which reduce the impact of advertising as a result of the conscious and unconscious elimination of advertising content takes place [15]. This contributes to the need to find solutions with the ability to model the structures and content of media and forms of communication, providing results at a certain level. The article presents the assumptions of interactive advertising objects with varying levels of impact on

target users and possibilities of multidimensional measurements. The presented concept allows the selection of design options and analysis of the interaction of verbal and visual elements in terms of their impact on the obtained effects. Results from empirical study showed practical applications of presented solutions and the relations between visual and text elements within online advertisements.

2   Role of Visual Components in the Interactive Communication

The use of electronic media in marketing enables two-way communication using visual components with the customer and allows researchers to perform measurement and analysis in several areas [9]. The concept of interaction and the available definitions were created in different stages of development of electronic systems. S. Rafaeli defines a recursive interaction as an interpersonal communication in which the exchange of data or information that relates to an earlier stage of the communication process is variable and the roles of sender and recipient are identified [10]. C. Heeter lists six dimensions of interaction that identify the information functions and the complexity of the communication process [4]. Different areas of mapping similarities between interpersonal communication and interaction with the electronic system were analyzed by J. Steuer [11] with determined the level of possible changes to the content and form of an interactive environment. These approaches draw a clear distinction between the interaction with the system and the human communication through electronic systems. D. Hoffman and T.P. Novak combine earlier definitions and refer them to the Internet, where interaction can occur both with the system in a form of machine interactivity and personal interactivity [5]. Interaction elements together with visual elements are combined with marketing messages and are affecting the efficiency and consumer behavior. Communication implemented in the online environment and visual components can take different levels of interaction that affect the perception of the media. Research in this area refers to the impact of media implemented in the form of banner ads on the effects and the role they play in the brand recognition or awareness [13]. The results presented by L. Hairong and J.L. Bukovac indicate the cognitive basis of the relationship between ad format, size, graphics, animation elements and their impact on the direct effects [3]. Important role in the communication process play elements in the form of verbal messages and graphics. They generate stimuli and impact is increased when the media components stand out among the previously transmitted messages or parts of website. There is an analogy to the traditional media, for which the characteristics of the impact and increase the effectiveness by changing the intensity of interactions and visual communication were analyzed among others by A.E. Beattie and A.A. Mitchell [1]. Within the websites increase the level of interaction can occur in both the visual and the verbal communication together with cognitive processes [14]. For the visual elements can be analyzed the impact of different communication options, ranging from less invasive forms to a high level of vividness and distinction. Limited perception creates the need for

increase the influence of persuasive messages. This includes animation elements which impact on the results analyzed in the first phase of the development of interactive advertising, including in the work of J.H. Ellsworth [2]. S. Sundar and others have studied online animated elements and determined their impact for similar static ads placed in print media [12]. Some of these aspects were addressed in our research based on fuzzy modelling and searching for compromise solutions using static aggregated data [6][8] and measuring the impact on web users with the use of difference of influence between repeated contacts with the website [7]. While complexity of online marketing content grows this requires the most common use of a combination of elements of verbal and visual impact. At the same time, the possibility of reducing the impact of verbal elements should be taken into account due to the introduction of graphic elements that absorb the attention of the recipient and help to reduce the significance of a text message in the decision-making process. The presence of many factors influencing the effectiveness of online advertising and dependencies between components, graphics, and text messages means that it is important to use analytical methods and tools to measure these phenomena and the use of acquired knowledge. The following research presented in this paper shows the concept of advertising object with the structure generated in an automated manner using different levels of impact on the recipient. This gives the ability to determine the design options that enable the integration of both information functions involving elements of text and visual impact in such a way that did not follow their mutual compensation.

3   Interactive Advertising Object with Varying Levels of Influence

A review of the literature reveals the complex factors that impact the effectiveness of interactive media. When designing advertising objects, the main goal of communication, as well as the levels of verbal and visual influence, must be chosen to achieve certain effects. The next part of the paper presents the concept of interactive component, which integrates the various elements of the impact in both verbal and visual for and generates ad unit structure in an automated manner with different levels of persuasion. This approach makes it possible to analyze the impact of verbal and graphic communication in a unified measurement environment and allows a comparison of the results obtained for different variants of transmission. The set of $R_i = \{G_i, T_i\}$ advertising components is designed to provide specific functionality and impact on the recipient and is divided into subset G_i with included graphic elements and T_i with text elements. The subsets G_i and T_i include graphic components $G_i = \{G_1, G_2, ..., G_n\}$ and text components $T_i = \{T_1, T_2, ..., T_m\}$ of advertising object through the generalized structure shown in Fig. 1.
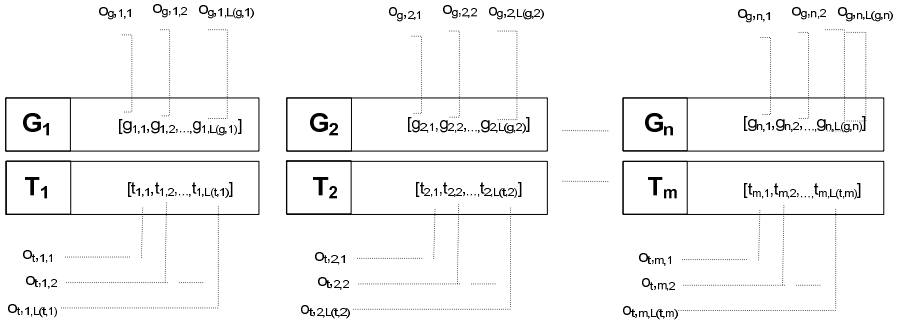
Fig. 1. Structure of the advertising object with varying levels of influence

Each item is determined by the number of options available in the case of graphic elements $G_i = \{g_{i,1}, g_{i,2}, ..., g_{i,Lg,i}\}$ and text elements $T_j = \{t_{j,1}, t_{j,2},..., t_{j,Lt,j}\}$, where $L_{g,i}$ determines the number of variants of a graphic element G_i, $L_{t,j}$ specifies the number of variants of the text element T_j. For each variant $g_{i,j}$ and $t_{i,j}$ levels of influence $o_{g,i,j}$ and $o_{t,i,j}$ of object are defined. The overall measure of the impact I_i of the object R_i consist of summarized L_G graphic elements and L_T text elements, expressed by the formula:

$$I_i = \sum_{j=1}^{L_G}\left(w_{g,i,j} * o_{g,i,j}\right) + \sum_{j=1}^{L_T}\left(w_{t,i,j} * o_{t,i,j}\right) \tag{1}$$

where $o_{g,i,j}$ represents the level of impact of a graphic element, $o_{t,i,j}$ describes the level of impact of a text element, according to $w_{g,i,j}$ and $w_{t,i,j}$ defined as a weights adopted for a given elements, which determines the strength of its impact on the remaining components. Thus constructed, an object can be used to test the system and determine the system model. In the process of exposure of an interactive object in the test user group request from the website is followed by selection of components and recording interactions. When generating a variant followed by selection of elements from the given selection function fs(E_i,R,n), which is responsible for the selection of an element E_i from the set R for call transfer n, the main objective is to replicate the system responses for different variants and to design and build a model of the system. The selection process takes place to generate an advertising object variant design and direct it to the user's browser. The measuring system collects data on individual exposures and outcomes achieved. Data is passed as a feed to the system model, where the provisioning model structures are in the feedback. In the following section, experimental research was conducted in a real environment, which aimed to verify the design and testing in relation to verbal and graphic elements of the media and their interactions.

4   Experimental Research in a Real Environment

A further step of work included the construction of an interactive component that included previously presented assumptions and a test of the configuration of the advertising message. In order to verify the presented solution experimental interactive object was developed with the selection mechanisms and integrated with the real system. Within the defined object, the components had different levels of impact on the recipient. The proposed solution was used in the module associated with the campaign implemented within the social network. The advertising object structure included four components of $T = \{T_1, T_2,\}$ $G = \{G_1, G_2\}$ with versification mechanism and included text elements $\{T_1, T_2\}$ and graphic elements $\{G_1, G_2\}$. T_1 element identifies seven versions of textual variants $\{t_{1,1}, t_{1,2}, t_{1,3}, t_{1,4}, t_{1,5}, t_{1,6}, t_{1,7}\}$ with different levels of interaction and integration of textual expressions with call for action messages like in this case *Click* or *Click now*. The text structure of indexes $t_{1,1}$, $t_{1,2}$, $t_{1,3}$ are pointed to the different characteristics of the social platform. G_1 element was carried out in the form of a graphic button in seven variants $\{g_{1,1}, g_{1,2}, g_{1,3}, g_{1,4}, g_{1,5}, g_{1,6}, g_{1,7}\}$. The first two variants $g_{1,1}$ and $g_{1,2}$ contained static objects without animation. The first showed less contrast with the background, while the second variant was more pronounced on the background. $g_{1,4}$ element contained animated text on a static background. $g_{1,5}$ variant contained animated elements with a higher level of impact. The most aggressive forms of animation were combined with elements of $g_{1,6}$ and $g_{1,7}$. Item G_2 included additional graphical information indicating the possibility of setting up a user account without costs. An animated version of the element was used for $g_{2,3}$ and the static version for $g_{2,2}$. For variant $g_{2,1}$ element G_2 was not visible. In the analyzed period component was displayed 249,149 times. Every possible combination of elements was shown 282 times on average. The message was generated for 27,338 unique visitors and 698 were registered during this period of interaction with measuring effectiveness using the click-through ratio. In the first step an ANOVA analysis was performed for all media options including the graphical elements, both animated and static, and verbal components. The analysis (Table 1) indicates the greatest impact on

Table 1. Analysis of data involving animated elements

Element	Effect	E	p	−95 %	+95 %	W
T_1	−0,010438	0,047150	0,824899	−0,103112	0,082235	−0,005219
T_2	−0,025659	0,037410	0,493154	−0,099188	0,047870	−0,012830
G_1	**0,099495**	**0,045404**	**0,028964**	**0,010254**	**0,188736**	**0,049747**
G_2	**0,078476**	**0,037475**	**0,036835**	**0,004820**	**0,152133**	**0,039238**
1L vs 2L	0,088441	0,057518	0,124877	−0,024610	0,201492	0,044220
1L vs 3L	0,054469	0,069385	0,432869	−0,081905	0,190843	0,027234
1L vs 4L	0,072525	0,057371	0,206861	−0,040236	0,185286	0,036262
2L vs 3L	−0,085040	0,055268	0,124615	−0,193668	0,023588	−0,042520
2L vs 4L	0,034075	0,045991	0,459152	−0,056319	0,124470	0,017038
3L vs 4L	0,043490	0,056396	0,441036	−0,067355	0,154335	0,021745

the aggregated results was represented by graphical element G_1 and G_2 element of levels of significance respectively $p(G_1) = 0.0289637$ and $p(G_2) = 0.0368348$. The results indicate the limited importance of the text message t_1 and t_2 when switching on animated graphics.

The next step was analyzed with the usage of response surface modelling used in the analysis of experimental results. The analysis shows the impact of Pareto effect level G_1 at the level of $P(G_1) = 2.19$, and the effect on the level of $P(G_2) = 2.09$. Positive values indicate an increasing change of the effects generated by the element on the level $G_1 = 1$ to $G_1 = 7$ and the G_1 element from $G_2 = 1$ to $G_2 = 3$. For the text element T_1 with value $P(T_1) = -0.22$, and for the element T_2 value $P(T_2) = -0.68$. The negative values reflect the direction of the impact element, which in this case occurs at the change from the seventh to the first variant of the element T_1, and the third to the first element of G_1. A small value indicates a minimal impact on the effects of text elements using different graphical components. In some situations, it may reduce the information function of the interface, because all the attention is focused on the recipient's graphic elements. The next step was to analyses the effects at different values of input parameters. The surface response, which represents the effect of changing the version of graphical element G_1 and G_2 for the effects of the variants of the text elements $T_2 = 7$ and $T_1 = 1$, is shown in Fig. 2. The analysis of the effects of changes in the value of $T_2 = 7$ and $T_1 = 2$ is shown in Fig. 3.
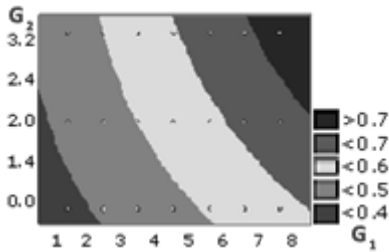

Fig. 2. Dependence of the effects of G_1 and G_2 for a constant value of $T_2 = 7$ and $T_1 = 1$
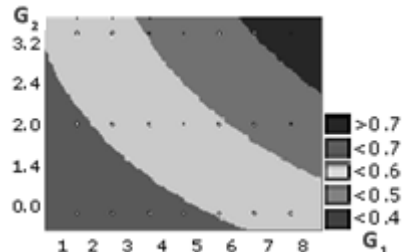
Fig. 3. Dependence of the effects of the values of G_1 and G_2 for the constant $T_2 = 7$ and $T_1 = 2$

These graphs show that when changing graphics variations, text elements do not substantially affect the results change. In this case, verbal communication has little effect on the call interaction, and its importance to the process of communication is negligible. This is confirmed by the analysis carried out for different levels of volatility text elements, the results of which are shown in Fig. 4 and 5. Changes to T_1 textual variants of the first embodiment to the seventh have virtually no influence on the obtained results. The analysis shows that the occurrence of animated graphical elements within media reduces the importance of the impact of verbal communication. Despite the difference in potency and text elements of persuasion used, the obtained results were not affected.
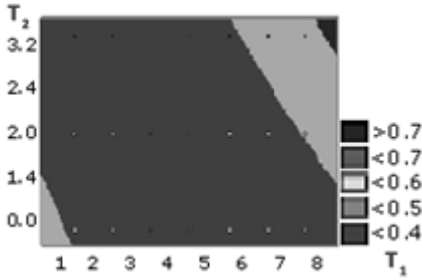
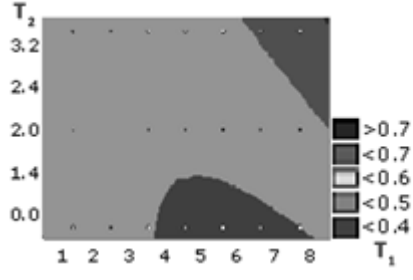Fig. 4. Dependence of the effects of the value of T_1 and T_2 for constant $G_1=3$ and $G_2 = 3$

Fig. 5. Dependence of the effects of values of T_1 and T_2 for constant $G_1 = 2$ and $G_2 = 3$

To assess their impact on the course of action, a set of variants containing graphic elements of the static low level of invasiveness was analyzed. This approach was designed to determine the effect of text elements on the obtained results and to determine their importance in the excluded animated elements. Table 2 presents the results of analyses carried out on media exposure to the exclusion of animated elements.

Table 2. Analysis of the effects of the absence of animated elements

Element	Effect	E	t(70)	p	−95,%	+95,%	W
T_1	−0,184993	0,100150	−1,84716	0,068950	−0,384737	0,014750	−0,092497
T_2	−0,009400	0,080628	−0,11658	0,907523	−0,170208	0,151408	−0,004700
G_1	0,033818	0,064521	0,52414	0,601839	−0,094866	0,162502	0,016909
G_2	−0,000417	0,063814	−0,00653	0,994810	−0,127690	0,126857	−0,000208
1L vs 2L	0,017946	0,064866	0,27667	0,782852	−0,111426	0,147318	0,008973
1L vs 3L	−0,013340	0,102003	−0,13078	0,896328	−0,216779	0,190099	−0,006670
1L vs 4L	0,046308	0,080860	0,57269	0,568687	−0,114962	0,207578	0,023154
2L vs 3L	−0,045112	0,099310	−0,45425	0,651054	−0,243180	0,152957	−0,022556
2L vs 4L	0,068797	0,079953	0,86046	0,392470	−0,090665	0,228258	0,034398
3L vs 4L	0,003517	0,132919	0,02646	0,978966	−0,261581	0,268615	0,001758

All variants were considered for the transmission of text elements T_1 and T_2, and a first and a second embodiment of both the element T_1 and the T_2 component. The analysis indicated the greatest effect of the text element T_1 (p = 0.068950), as shown in Table 2. Pareto analysis results for this set of data indicate the impact of the element T_1 at $P(T_1)$ = -1.84. Orientation effects on growth effect are the same as in the previous analysis, the change values as $P(T_1)$ = -1.84 obtained when incorporated with animated elements level $P(T_1)$ = -0.22 indicates that text was increasing the impact of graphic elements. For the text element T_2, the effect is much smaller and takes the level of $P(T_2)$ = -0.11. This is consistent with the concept of the project and the choice of font sizes with the larger format for an element T_1. Fig. 6 shows the influence of the effects of changes in textual variants with static media versions G_1 and G_2.

With the limited impact of graphics, changes of T_1 and textual variants are reflected in the obtained results. Fig. 7 shows dependences of design variant $G_1 = 2$ and $G_2 = 2$, which represents the static graphic elements contrasting with the background site better than with variants $G_1 = 1$ and $G_2 = 1$. Even with such a selection of textual variants, the influence is clearly visible.
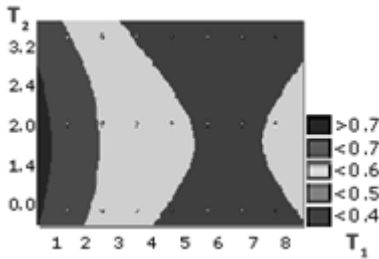

Fig. 6. Effects depending on the value of T_1 and T_2 parameters for static graphic elements $G_1 = 2$ and $G_2 = 1$
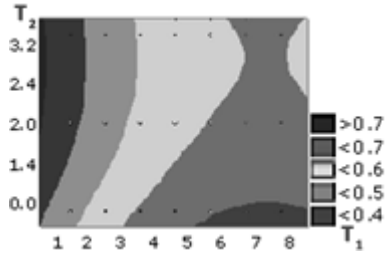
Fig. 7. Dependence of the effects of the values of T_1 and T_2 for static graphics $G_1 = 2$ and $G_2 = 2$

The analyses indicate the possibility of reducing the importance of the impact of verbal communication represented by textual messages in an interactive environment with the exposure of associated graphics with a high impact on the recipient. This effect should be taken into account when the purpose of advertising is to direct text messages of a certain informational value. In this case, it is important to reduce the visual impact of other elements. The results also point to the need for analysis of the issue of advertising within websites with a large number of graphic elements that absorb the attention of the recipient and hinder the perception of verbal communication. The selection of components may be implemented in an automated manner by eliminating variations towards best results. The conducted experimental studies show one of the areas of application of ad units with varying versions of the components that make it possible to carry out detailed analyses of the effectiveness of advertising campaigns.

5   Summary

An analysis of elements influencing the effectiveness of interactive media indicates the presence of a number of factors that determine the effectiveness of advertising campaigns in the online environment. The advertising message integrates many elements, both verbal and graphic, which in combination can act on the recipient with varying intensity. The proposed approach to advertising design, i.e. breaking it down into its components, makes it possible to test different design options and determine the relationships that exist between the components. This approach uses the electronic properties of the environment and the ability to integrate with adaptive websites. The conducted experimental studies indicated that the impact of individual components and reduced the share of verbal communication in parallel using the graphical

elements of the greater intensity of impact. Simultaneous use of these elements makes verbal communication have a large effect on the interactions generated by the user. The introduction of dynamically generated elements with different levels of interaction allows the selection of the structure of the message, which provides an acceptable level of results. Future work assumes testing different scales of influence and adding more testing dimensions based on vividness effect, animations with the different intensity and frequencies towards more generalized results and model.

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