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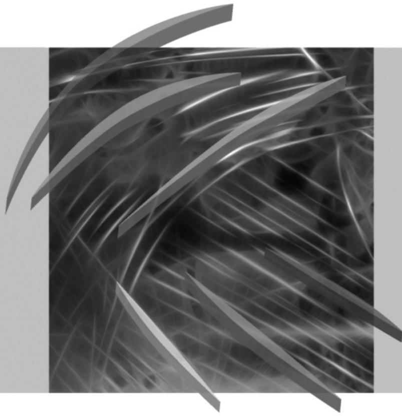

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Information Systems in Business

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COMPROMISE APPROACH TO EFFECTS-ORIENTED WEB DESIGN

Abstract: Web applications require the integration of different areas in the field of usability, information architecture and elements influencing user behaviour. In particular, it is related to the effects-oriented websites designed to generate specific interactions. Various forms of media and interactive objects such as banner ads, landing pages, or the active elements of websites are used in this area. A conflict can be identified between the need to achieve results, and ensuring an adequate level of usability. The approach presented in this article is based on the decomposition of interactive elements and compromise solutions with the main goal to generate results at a certain level while maintaining a low intrusiveness of the website.

Keywords: website effectiveness, human-computer interaction, web design.

1. Introduction

The web design process should provide applications that match users' preferences and needs. To meet requirements and improve user's experience, the system usability and functionality are analysed with the use of evaluation methods [Ivory, Hearst 2001], heuristics [Flavian et al. 2009] and other approaches [Zimmerman, Akerelrea 2004; Sharp et al. 2007]. Evolving business models and growing competition on the electronic market requires attention from designers to other areas of applications such as effectiveness and overall business performance. In recent years, the significant trend is the design of effect-oriented Internet websites, especially when they play a key role in business processes or sales platforms. Different forms of interactive objects are used in the communication process, such as multimedia elements, navigation systems, banners and others. The interactive message is, in such cases, integrated with both verbal and visual persuasion and social engineering elements. Its task is to increase the number of interactions expected by the website operator like signups, clicks and purchases using call to action messages and elements influencing user behaviour. Performance is represented by conversion factors measured such as the number of effects in relation to the number of visitors. Conversion maximization is often accomplished at the cost of other parameters of system usability assessments and this can increase its intrusiveness [Rohrer, Boyd 2004]. Intrusiveness is defined as the perception or psychological consequence that occurs when an audience's cognitive processes are interrupted [Ha 1996]. In relation to the website's elements, intrusiveness can be considered as the degree to which the website's content is trying to change users' behaviour and negatively affects the user's experience by increasing stimuli. The article herein presents the approach based on a compromise between web design and the results of experiments with the main goal of finding a balanced approach to deliver results at accepted levels with an interface that offers limited intrusiveness. The experimental interface was designed as a set of elements of varying levels of influence focused on generating redirections to a targeted section of the analysed website. The experiment included measurement of both the desired effects and negative reactions of the recipient and the selection of the design. The structure of this article is as follows: the second section presents the evolution of sites in the direction of effects-oriented systems and research areas in this field. The third section presents the assumptions of a compromise approach and the aggregated measure of the influence of interactive objects. The fourth section presents the results of experimental research conducted in the real environment. An example procedure for searching for compromise solutions and future areas of research are presented in the fifth section.

2. Motivation and related work

Website design integrates several areas of human-computer interaction and fields such as computer science, sociology and psychology of human factors [Sears, Jacko 2007]. The structure of interaction elements and navigational interfaces with the information architecture (IA) [Morville, Rosenfeld 2006] and various aspects of user-centred design (UCD) [Vredenburg et al. 2002; Green, Pearson 2006] play an important role. Apart from user-centred approaches, evolution is observed in the area of marketing content towards conversion oriented websites [Tarafdar, Zhang 2005]. A. Schlosser identifies this trend and discusses the main elements connected with website design that influences the acquired results [Schlosser 2006]. The analysis of effects within the website is most commonly realized in relation to user actions that are desired by the website operators [Barnes, Vidgen 2002]. Several elements of a website can be analysed and different types of interactions can be measured. Among others, these include number of users interested in certain offers, the percentage of returning users, number of visited pages, duration of the visit and individual interactions within the website or the number of subscribers [Rayan 2008]. Earlier measures used, such as the number of external links pointing to the target web page, the number of times the website has been accessed, or the duration of a website visit, gave only a general view on the issue of users' behaviour and have a limited impact on the decision process [Kaplanidou, Vogt 2006]. Another possibility is behaviour analysis in the frames of the session and of dynamic modelling of navigation paths, which provides a more accurate measurement of the actions undertaken by a user [Kelly 2008]. Here we can observe the possibility of making comparison analyses of users' segmentation on such a basis. As it is emphasized by M. Pearrow, the examination of various factors' influence on design, evaluation and product usage is more commonly applied in this field [Pearrow 2000].

The perception of messages is one of the elements used to indicate effectiveness and if the goals assumed for a website have been achieved [Bernard 2010]. A conceptual website model is available in which cognition and emotions are combined to aid in understanding behaviour in an online environment [López, Ruiz 2011]. Discussed strategies should be undertaken within the website's optimisation process and should include, among others, call to action, persuasion, and animations connected with interactive objects. The aim of implemented text and graphical components that call to action is to use the elements of persuasion to encourage a user to perform a certain kind of action in the scope of the target website. Perception within the context of an Internet system is observing the conscious reaction of a sense organ to an external stimulator. The reaction and the receipt of the sensations are based on the supplied electronic content. In order to increase effectiveness, the designers must take into account the occurrence of desensitisation and limited perception of provided marketing content connected with sensory adaptation [Burke et al. 2004]. In the communication process, users do not typically view the entire text of the website and interaction occurs in the form of quick content scanning. Overcoming the limited ability of users to process information leads to attempts to acquire the user's attention using different methods, such as animated elements, vivid effects and luminance analysed earlier in the research related to visual search [Turatto, Galfano 2000]. All of these areas can lead to an increase of Internet website intrusiveness, which is observed in relation to various forms of online advertising, and creates a negative response from web users [Leggatt 2008]. The saturation level can be achieved where increased persuasion factors do not lead to further increases of website effectiveness because of the limited ability to process information. In such conditions proposed in this paper, a balanced approach can be applied. It enables the acquisition of an acceptable level of effects without having excessive influence on users in a form of compromise solution. In the next part, the general assumptions of the proposed approach and results of experiments are presented.

3. Approach based on modelling of compromise results

One of the areas influencing the results achieved within a website is modelling the interface's structure and architecture of information to acquire a certain level of results. In this section the structure of interactive elements is presented, which enables the determination of the influenced levels and analysis of how increased persuasion intensity reflects the acquired results. Web platform interfaces can be identified as interactive objects integrating the components that influence the user and provides the possibility of generating individual interactions. In relation to systems focused on direct effects, the main aim is to acquire a certain kind of influence, which can be determined in different ways, depending on the scope of the system and business model. The interactive object with separate components, whose task is to provide individual functionality and level of influence on a user, was introduced earlier [Jankowski 2011]. For every object that is defined a set of available components determined by $E = \{E_1, E_2, \ldots, E_n\}$ and for every E_i there is a number of available variants $E_i = \{e_{i,1}, e_{i,2}, \ldots, e_i, cnt_{(i)}\}$ where $cnt_{(i)}$ describes the number of variants available for the *i*-th element. For every component $e_{i,j}$ can be assigned influence level $l_{i,j}$ which defines the strength of persuasion on a user. In order to measure total selected variant influence, the aggregated interaction measure can be used, which consists of a sum of partial levels. We assume that total influence can be represented by aggregated influence measure AI_i of object E_i consisting of k elements according to the following formula:

$$AI_i = \sum_{j=1}^{k} (l_{i,j} * w_i), \tag{1}$$

where: $l_{i,j}$ – influence level defined during the design process,
w_j – rank assumed for a given element based on effect size from analysis, which defines the strength of influence in relation to other elements.

To compute the compromise design there is need to measure both positive effects (response) and negative effects (e.g. blocking interface or exiting website) in relation to the aggregated website's influence. Compromise results are based on a balanced approach where the total aggregated influenced measure is not affecting user's experience while it is delivering results assumed by the designer. In the process of transferring the interactive object to a group of system users, a selection of components and interactions is registered. The implementation was based on the full factorial experiment with all variants tested, which was aimed at obtaining information on the relationship between levels of persuasion and their influence on the results obtained. In the next step based on the obtained results the process of identification of compromise design was established, which provides an acceptable level of performance with limited intrusiveness of design.

4. Experimental research

In the next part the research included engineering component construction, integration with website, and initial data analysis. The interactive object was located at an example website with the main goal of causing actions in the form of mouse clicks on the interface and as a result transferring users to other informative target landing pages. The experiment was conducted with two main research goals. The first goal was based on fuzzy modelling and the integration of collective knowledge in inference models during the web design process presented earlier [Jankowski 2011] and related to compromise design presented in this paper. Figure 1 presents the structure of designed interactive object in the form of website elements consisted of three sections: S_1, S_2 and S_3.

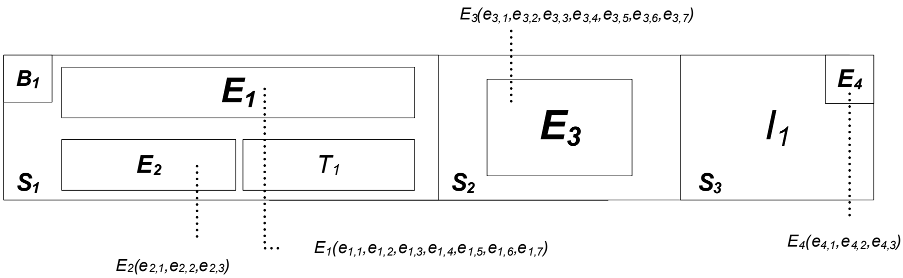

Figure 1. The structure of an experimental interactive object

Section S_1 was based on the text influence of elements; in section S_2, a graphical element with call to action content was included; graphical elements with informational functions were located in section S_3. In the objects area were located elements $E = \{E_1, E_2, E_3, E_4\}$ assigned to sections which were subject to versification and different variants of design. Two elements of design, T_1 and graphical element I_1, were not subject to versification. Element B_1 was an additional element with two possible states, with the option to remove the interactive object from the user's screen and resulting in blocking response *BR*. It helped to measure the intrusiveness level and detect at what stage users where more willing to disable this content. For all other elements were assigned sets of possible design variants.

Element E_1 was assigned to a set of seven versions of text variants $\{e_{1,1}, e_{1,2}, e_{1,3}, e_{1,4}, e_{1,5}, e_{1,6}, e_{1,7}\}$ with integration of call to action expressions and different levels of influence l_i with assigned incremental values as follows: $l_1 = 1$, $l_2 = 2$, $l_3 = 3$, $l_4 = 4$, $l_5 = 5$, $l_6 = 6$, $l_7 = 7$, similar for all other elements. For E_2 there were assigned text variants $\{e_{2,1}, e_{2,2}, e_{2,3}\}$ with different influence and incremental call to action levels. Element E_3 was designed as a graphical button with a call to action text in seven variants $\{e_{3,1}, e_{3,2}, e_{3,3}, e_{3,4}, e_{3,5}, e_{3,6}, e_{3,7}\}$. Variants $e_{3,1}$ and $e_{3,2}$ were static, variant $e_{3,4}$ was based on flashing animated text, variant $e_{3,5}$ flashed more intensively up to $e_{3,7}$ level with the highest flashing frequency and highest potential intrusiveness. The last element E_4 included persuasion functions in three design variants. The presented object had a total $V = 882$ possible design variants in the full factorial experiment. In the next phase, the experiment was conducted in a real environment, it was determined the object was displayed 249,149 times within a test web page. Every possible combination of elements was exposed approximately 282 times. The message was generated for 27,338 unique users. In the analysed period the system registered 698 interactions with different response *R* measured as (number of interactions/number of impressions) * 100% and *BR* response calculated as (number of blocking interactions/number of impressions) * 100%. Table 1 shows variants with the highest and lowest response values.

Table 1. Subsets of response values for selected variants

High and low *R* response instances						High and low *BR* response instances				
E_1	E_2	E_3	E_4	R[%]		E_1	E_2	E_3	E_4	BR[%]
7	2	2	3	0.2865		2	1	1	3	0.3115
2	1	7	3	0.2994		2	1	1	1	0.3115
6	2	5	2	0.2994		5	1	5	2	0.3115
3	2	5	2	0.3039		7	2	5	2	0.3134
5	1	3	1	0.3086		7	3	4	1	0.3144
5	2	6	1	0.3095		6	3	3	2	0.3164
3	2	1	3	0.3105		4	3	1	1	0.3184
7	1	1	2	0.3115		4	1	6	1	0.3184
…						…				
1	1	1	2	1.4652		2	2	3	3	1.0489
1	2	2	3	1.4652		7	2	6	3	1.0909
6	1	7	2	1.4705		4	1	3	2	1.1029
6	2	5	1	1.6326		5	1	7	3	1.1152
2	2	6	3	1.7421		2	2	3	1	1.1320
4	1	6	2	1.7482		1	2	7	3	1.2861
4	2	3	1	2.2222		6	2	2	1	1.2931
5	1	6	3	2.4054		5	1	5	3	1.3201

Response *R* represents expected interaction with object (user click in this case) and *BR* represents blocking response represented in this case by clicking option to remove content (cross button in the top right corner of the header). In the next phase and analysis was made of the individual influence levels li and the average response value *R* was determined for all elements. Next an analysis was made to indicate whether the combination of elements influenced the acquired effects. The aggregated influence measure AIi was introduced for certain project variants, as well as ranks being introduced for individual components.

5. Response analysis towards selection of compromise design

In the next phase, an analysis was made of acquired results using methods relating to response analysis in the full factorial experiment. The conducted analysis indicated the significance of elements E_3 and E_4 at the levels respectively $p(E_3) = 0.028959$ and $p(E_4) = 0.036837$. The acquired results indicate the limitation of text information and text message significance on overall intrusiveness. In some situations it can lead to limitation of the informative function of the interface, where all of the user's attention is drawn to graphical elements. The dependencies and influence of individual

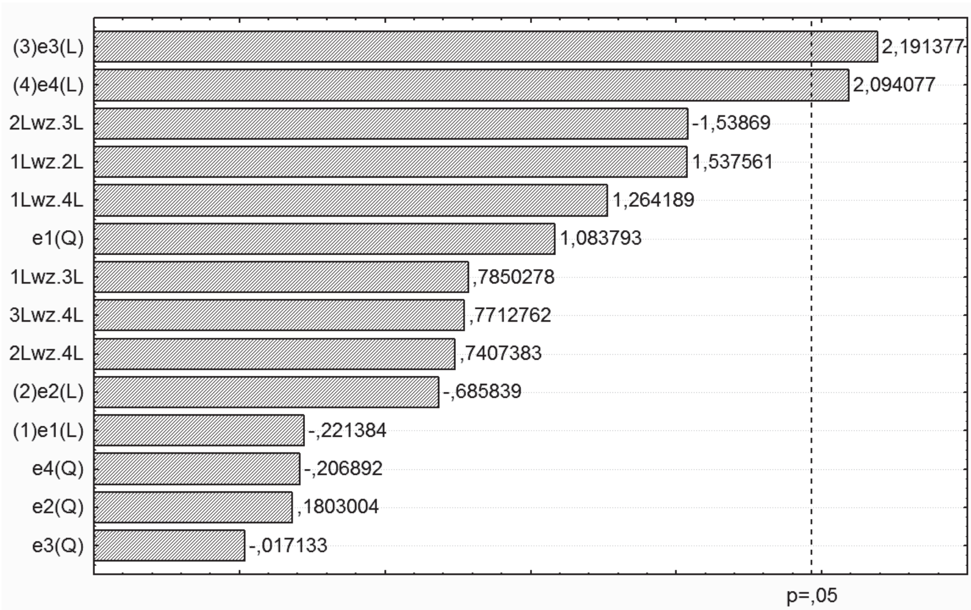

Figure 2. Pareto chart for individual input parameters

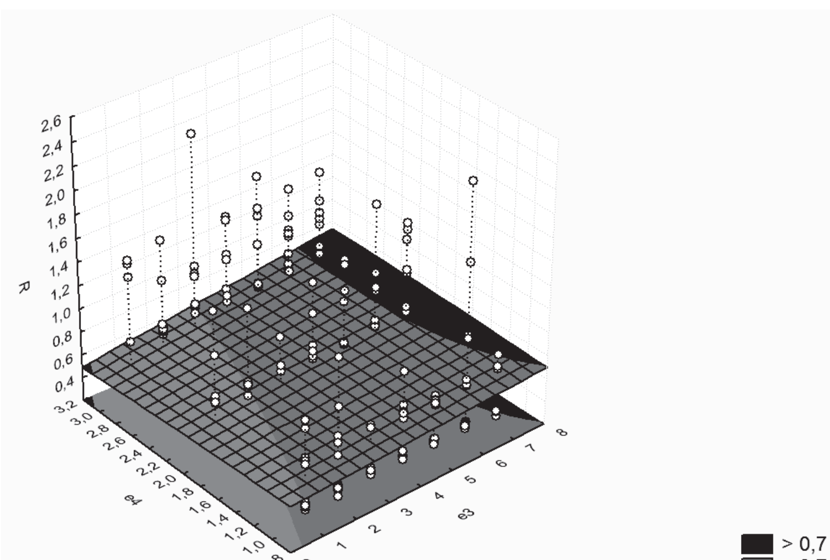

Figure 3. Dependency of R on values of E_3 and E_4 with constant value of E_2 and E_1

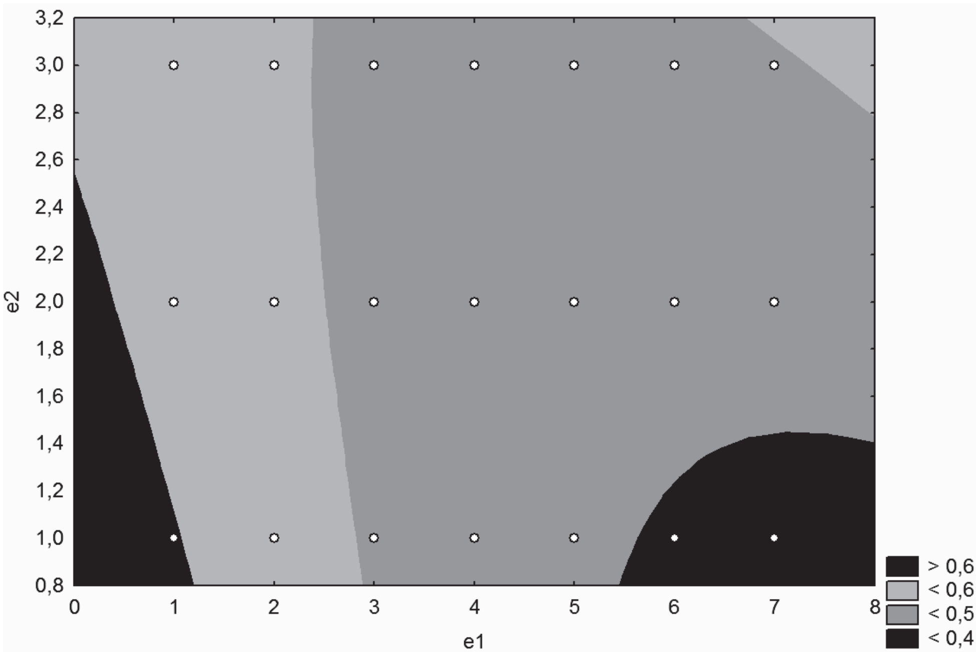

Figure 4. Dependencies of E_1 and E_2 for minimum values of E_3 and E_4

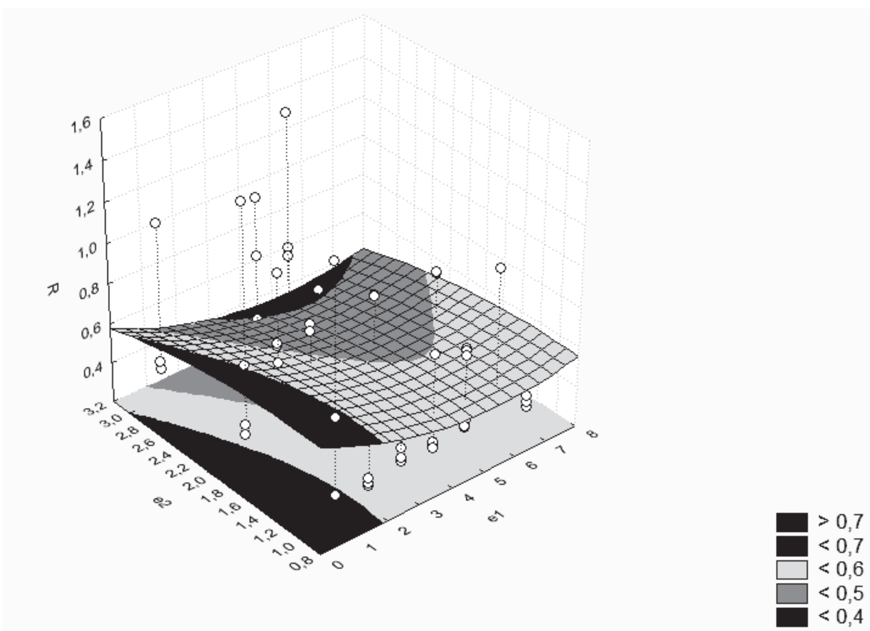

Figure 5. Response for parameters E_1 and E_2 with assigned levels $E_3 = 1$ and $E_4 = 1$

elements were illustrated by the Pareto chart (Figure 2), on which for the 2.19 and 2.09 input parameter values were acquired. This chart reflects levels for which the increase of value of a chosen element cannot be done without a decrease in the other values. For the main influential elements, the response surfaces were examined with the constant value of E_1 and E_2 at the minimal level. Figure 3 shows the response surface, which indicates in what scope the system response R increases during increase of the influence level of elements E_3 and E_4. The analysis conducted for text elements E_1 and E_2 with minimum values determined for E_3 and E_4 was presented in Figure 4. These charts show that at the minimum influence level of graphical elements the text structure influences the acquired effects, but when the level of the graphical elements invasiveness increases and the whole sample is analysed, the level of text elements significance radically drops, as confirmed by ANOVA analysis.

Loss of user's attention after the introduction of animated elements with a high level of influence hindered the research into the influence of text elements and analysis in the role of the process of generating interactions. In order to estimate the influence of text messages, the subset was analysed, which included the message instances without animated elements. It related to all expositions, for which for element E_3 the variants $e_{3,1}$ and $e_{3,2}$ were selected, and variants $e_{4,1}$ and $e_{4,2}$ were selected for element E_4. Figure 5 presents the approximated distribution of response dependency of the values of E_1 and E_2 at the minimal level of parameter E_3 with element E_4 being turned off (lack of displayed information about service being free of charge). Additional analysis showed that attachment of E_4 informing about the service being free of charge without animation increased the effects. Moreover, when the element E_3 was added with a bigger contrast over the background (variant $e_{3,2}$), there was improvement of effects and strengthening of the influence of E_2. The analysis indicated that the reaction to a text generated for an object E_2 could increase, together with increased graphical influence. Figure 6 shows the interaction distribution depending on the influence levels. Despite there not being a big amount of measurement data, it is possible to observe according to the trend line the increase of influence from the level of $R = 0.49$ to the level $R = 0.62$, which gives the approximate increase by 26% of system response during the increase of aggregated influence levels. Having such data enables us to determine the limit to which the influence level can be decreased so the intrusiveness is lower and the response is maintained at the acceptable level. Combination of influential elements does not significantly cause an increase of R in the geometrical way; and this increase is small, taking into account the differences in responses between variants with the smallest influence level without an animated and flashing element. It indicates the possibility of the occurrence of limited perception: when the influential element is already visible, other effects are not efficient. Based on effects from Figure 2 can be calculated and the influential measure of the design variant can be aggregated. Level of design is multiplied by effect with 2.1913 for E_3, 2.0940 for E_4, 1.0837 for E_2 with –0.6858 and E_2 –0.2213. Aggregated value is computed for each design variant. Figure 6 shows that for increasing aggregated measure *AI* for the design variant its response rate *R* grows with a trend represented by a regression line. Response grows from 0.45 up to 0.65. Together with the growth of the response and higher values of *AI* is received higher *BR* rate representing the estimated intrusiveness of interface. The chart uses a value of 1-BR for better illustration, which shows an increase in invasiveness on the decreasing chart dotted line.

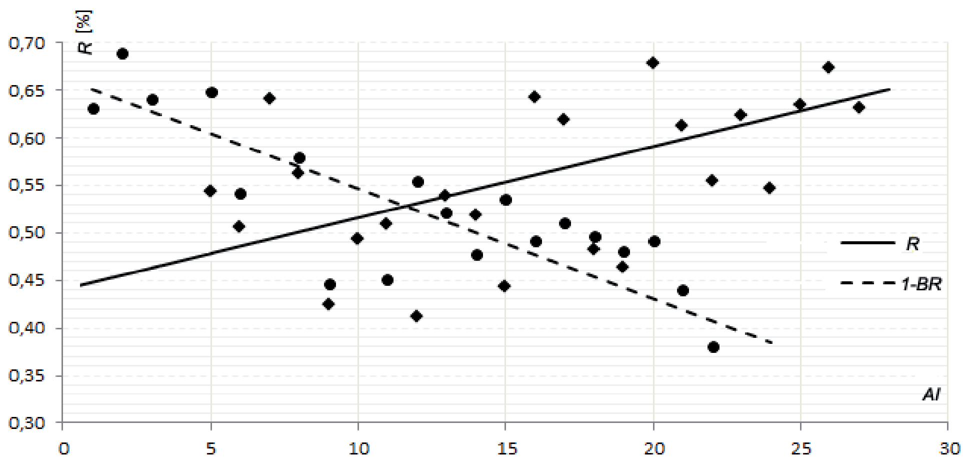

Figure 6. Response rate *R* in relation to blocking actions *BR* and C region with compromise solutions

Results represented by the response *R* with respect to the degree of intrusiveness represented by a (1 – *BR*). On the *X* axis was determined the aggregated impact of *AI* and on the *Y* axis response, expressed in the percentage of the number of interactions per a hundred exposures both for *R* and *BR*. The direction of the regression lines shows increase in the number of interactions *R* (solid line) and increase of *BR* (dotted line) caused by increased intrusiveness. The final design can be selected depending on the level of compromise represented by the region C on the graph containing design variants, where conversion rates are obtained from 0.53 to 0.55% (higher than 20% of the minimum level) while maintaining a measure of intrusiveness interface, 1 – *BR* at the level of 0.55%. The implementation of the presented approach enabled to reflect on the occurrences appearing in an interactive environment and may lead to better understanding of the dependencies. The presented solutions and approach towards the construction of compromise interactive objects can be used during the design of the marketing message or components of effects-oriented websites. The final scope of compromise solutions is dependent on the range of variation of the monitored elements and expectations of the designer. Introducing the decomposition of the object into its constituent parts makes it possible to monitor the effects on the level of invasiveness of interactive elements. An adopted level can be set in the decision making process and dependent on the website designer's preferences. The conducted research proves that multidimensional increases of influence levels caused by implementation of invasive elements in the message do not necessarily result in better effects. The compromise result can be based on the selection of design variants delivering both user experience and effects at an acceptable level. A limitation of the proposed method is the need to introduce measures of impact, which may be determined subjectively. Estimating their impact on the final effect required testing of a large number of combinations of design options. Adoption of aggregated measures of the impact may require additional studies in the presented area open research directions that can be explored in the future.

6. Conclusions

Effects-oriented websites are designed toward delivering results at expected levels which can be measured with different factors. The main business goal is usually interacting with user-centred design and system usability and can in some cases negatively influence the user's experience. This article illustrates the whole process of interactive object construction from the conceptual level through application elements and analyses of acquired results to construction of compromise solution. The approach presented in this paper makes it possible to deliver a balanced solution, however, it is still in the early stages of research. Similarities between influence elements indicate the complexity of the problem, where the acquired results are influenced by different factors. The specification of those relations requires the usage of analytical methods, which enables better system understanding and adjustment of project solutions to conditions occurring in the system. This approach can be conducive to the development of the concept of proposed compromise design, where the determined levels of effects are guaranteed, but the excessive interface intrusiveness is limited.

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PROJEKTOWANIE KOMPROMISOWE WITRYN INTERNETOWYCH ZORIENTOWANYCH NA EFEKTY

Streszczenie: Projektowanie aplikacji internetowych wymaga integracji zarówno obszarów powiązanych z użytecznością oraz architekturą informacji, jak i elementów oddziaływania na zachowania użytkownika. W szczególności dotyczy to witryn zorientowanych na efekty, które mają na celu generowanie określonych interakcji za pośrednictwem różnych form przekazu i obiektów interaktywnych, takich jak banery reklamowe czy strony docelowe. Występuje tutaj konflikt pomiędzy potrzebą generowania określonych rezultatów a zapewnieniem odpowiedniego poziomu użyteczności. Prezentowana w artykule koncepcja oparta jest na dekompozycji elementów składowych witryny i umożliwia poszukiwanie rozwiązań kompromisowych. Głównym założeniem jest generowanie efektów na określonym poziomie z jednoczesnym zachowaniem ograniczonej inwazyjności witryny.