# THE FACTORS OF EFFECTIVENESS AND THE ORGANIZATION OF THE SEARCH OF ELEMENTS WITHIN A GRAPHIC INTERFACE

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***Abstract.*** *In our experimental study we analyzed the impacts of the following groups of factors (1 – low-level factors: the physical components (i.e. color grade) of the explored context; 2 – high-level factors: the format of the stimulus presented, which determines the accuracy of the search query; 3 – intermediary factors: subjective estimates of the familiarity and attractiveness of the stimuli) and their impacts on the search rate as well as the organization in a simulated interface that contains graphic elements. The obtained results demonstrated multiple effects of the high-level factors and intermediary subjective rating on search time and the organization of eye-movement activity. When the searched stimulus was presented in the form of a word, the search for graphic elements (icons) on the interface happened to be slower and was characterized by longer fixations in combination with short-amplitude and low-speed saccades. When the target stimulus was set as an image, the search was quick, the fixations were shorter and the saccades had a longer amplitude and higher speed. A stronger familiarity with an element had a positive effect on the rate and scope of the search. However, a higher attractiveness led to a slowing down of the search process. Although no particular effects of the low-level factors were observed in this experiment, it was demonstrated that the color grade of the stimulus pattern (matrix) might have an impact in situations when the stimulus is presented as an image and its subjective attractiveness increases. This kind of evidence creates new possibilities in the area of interactive interface development.*

***Keywords***: *visual search, eye movement, graphic interfaces, websites*

***ACM Classification Keywords***: *Human centered computing, HCI, user studies, interaction paradigms, graphical user interfaces*

## 1. INTRODUCTION

Visual search is one of the key fields of study in cognitive psychology. Treisman and her colleagues laid the foundation for the experimental approach in this area in the early 1980s [Treisman, Gelade, 1980]. The goal of visual search implies detecting a specific target in a display filled with distracters. The targets can be presented to subjects in various templates, i.e. imagery or verbal. In classical experiments on visual search each stimulus was introduced as a clear and simple verbal description of the target and in later experiments stimuli were presented as images [Malcolm,Henderson, 2009]. The study of visual search remains relevant up to this day. However, we can witness a significant shift in this area. Researchers analyze the process of searching for realistic, semantically rich objects in complex visual contexts [*see* Eckstein, 2011].

The development of internet-based technologies has created new contexts and goals for visual search studies. Web pages differ from traditional stimulus materials and represent a complex combination of textual, imagery, and multimedia elements [Pogue, 2013]. This raises new questions concerning the way visual search is organized in a virtual environment and the factors that underlie its effectiveness [Hall-Phillips et al., 2013]. Our research is focused on the mechanisms of detecting graphic elements among similar distracter-stimuli. Although searching for icons on a screen is a familiar task for every computer and mobile device user, this process is the least studied in this area of research. Symbolic images (icons) have long been used in the development of tools for human-computer interaction [Garcia et al., 1994]. At first, the pictographic dictionary was relatively small, easy to memorize and use. However, with the development of internet-based technologies, it has been growing exponentially and is becoming virtually infinite. Anyone can create his or her own web page and fill it with various graphic content. It increases the interest in studying the mechanisms of visual search, perception, memorizing, and identifying pictograms [Goonetilleke et al., 2001]. For web users the pictograms can either merely exist as elements of visual design or play the role of defining points or indicators of a particular block of information. In some cases, they can even appear as the means of transition from one web page to another or from one block of information to another. Anyway, they can be viewed as the representation of access to a source of information [Hout, Goldinge, 2015].

Icons, as the representation of access, possess physical and semantic characteristics. Physical characteristics include movement, orientation, shape, size, color, etc. In his work, J. Wolfe describes dozens of such categories. Those characteristics are typically called low-level characteristics of cognitive processing [Wolfe, 1998]. In the 1980s, the icons used to be black and white and always had a frame. Later on, different variations of icons would appear and very little was done to analyze the purpose of those innovations. In our research we attempted to verify how the effectiveness of visual search depends on whether the graphic elements are presented in black and white or in color and whether they have round or square-shaped frames.

Semantic characteristics are connected with the ability to determine or complete the meaning of the searched element and are often described as the higher-level characteristics of cognitive processing. One of the possible ways to manipulate semantic parameters is with a search query or, in particular, the format and target template of the searched element. When analyzing the mechanisms of visual search, the target stimulus can be set as an image, a word, or even as a text. In the first case, we model a strictly defined task for visual search. For instance, a subject can search for the icon that represents a folder with deleted items, commonly known as Trash. All users have seen this icon multiple times, remember it well, and possess an accurate mental representation of it. They know what they search for. However, even in this case, the search takes some time because the icon can be located in various parts of the screen or appear in a cluttered context (when there are too many icons on the Desktop).

If the target stimulus is set verbally, a less defined task for visual search is modeled. A search of this kind occurs when we do not know precisely what the target icon looks like but can predict it by constructing mental images. As an example, we used a website that sells tickets for different kinds of transportation. The task was to find the icon that directs the user to the 'air travel' category. If the web site is being used for the first time, it is impossible to say with certainty what the icon will look like. However, the user can presume that it might look like a plane, wings, or anything that can be associated with aviation. A mental activity of this kind is equivalent to the one that is described by specialists in the field of information search as *search query reformulation* [Sutcliffe, Ennis, 1998]. One of the goals of our research is to compare the different types of search processes.

The low and high-level factors can be viewed as the objective search conditions. However, one should not ignore the subjective aspect, such as a user's evaluation of familiarity and attractiveness of the searched element. These factors can be described as intermediary variables. In addition, the familiarity depends on the user’s experience interacting with a similar stimulus in the past, whereas the attractiveness can be related to the user’s emotional reaction.

The familiarity influence of target stimuli and distracters on the search rate and strategy has been the subject of previous research. The topic of familiarity is related to the impact of the user's experience interacting with the searched element or context. In one of Treisman's studies [Treisman, Vieira, Hayes, 1992], it was determined that prior encounters with the stimulus patterns sped up the search process. Moreover, the correlation between the familiarity of the stimuli and distracters also plays a significant role [Malinowski, Hübner, 2001]. Nevertheless, the effects of familiarity are not as clear when a search for a real object is involved, e.g. a company’s logo or interface icon [Qin, Koutstaal, Engel, 2014]. In this case, it is important to consider the correlation between the familiarity and both low and high-level factors [Shen, Reingold, 2001].

The attractiveness effects of target stimuli on the search process have been studied to a lesser degree. This might be explained by its higher level of subjectivity in comparison to familiarity [Salimun et al, 2012]. The primary interest here is focused on the perception, search, and detection of faces [Rhodes at al, 2003]. However, the attractiveness and esthetic value of realistic and symbolic images also has critical importance, especially when interface elements are involved [Hou, Lu ,Ho, 2011]. The most important concern is the relation between the attractiveness and certain esthetic, particularly the color aspects on the web site as well as the characteristics of the search query.

Traditional studies on visual search normally attempted to minimize the number of eye movements in the process. However, the size and complexity of natural scenes have created the need for the analysis of eye movement activity and other behavioural components of the search process [Atkins et al.,2006]. The term *active vision* has been introduced [Halverson, Hornof, 2011]. Faraday [2000] has proposed the term *web page viewing behavior* and defined it as a series of eye movement acts. From our point of view, visual search can be defined as a consistently organized activity that carries a goal, set of conditions, achievement strategy, performance control, and so on. Nowadays, researchers in the field of eye movement analysis take into account a considerable number of factors, the main ones being fixation time, the amplitude and pace of saccades[1]. Furthermore, in the experiments on target search the so called *dwell time* is described as the time spent in the zone of interest, a part of the stimulus pattern where the searched element is located.

As far as visual search on web pages is concerned, prominent results have been achieved that connect the effectiveness of visual search and the way the virtual environment is organized with the parameters of eye movements. In one study [Pan et al., 2004], the oculomotor criteria of visual search were registered on 22 web pages. It was found that they depended on the web site's style, information organization, and the user's gender. In another study [Burmistrov et al., 2015], it was illustrated that the icon search was connected with the general design of a web page. The researchers studied the effectiveness of visual search and the patterns of the eye movement activity in relation to different visual styles of user interfaces: traditional or flat. The results showed that the participants required double the time to spot flat icons in comparison to more realistic, three-dimensional ones. The studies of oculomotor parameters have demonstrated that recognizing flat, two-dimensional pictograms in comparison to three-dimensional ones is usually characterized by lower levels of amplitudes and peak saccade rates. These results suggest the following conclusions. The first and more obvious conclusion explains the correlation between visual search and the web page's esthetic appearance. Secondly, the effectiveness of a search is related to the specific organization of oculomotor activity. Specific eye movement patterns can be singled out that may be able to predict a more or less effective search process.

[1] A saccade is a rapid movement of the eye that adjusts the vision system towards information analysis within a certain segment of the surroundings. A fixation is a period of motionless gazing which is traditionally considered as the point of information processing. Modern researchers seek to establish and substantiate the integrative criteria of the eye movement activity.

In this study, we focused on the roles of low and high-level cognitive processes, subjective evaluation of familiarity and attractiveness of the stimuli, and the way these factors affect the search rate and organization of eye movements. For the low-level factors, we decided to consider a physical characteristic, such as color grade. For the high-level factor, we agreed to consider the format the stimulus was presented in: a picture or a word. If the target was set as a picture, the subject had to store it in the working memory and to compare it with those he or she saw on the screen. If the goal was set as a word, the subject was required to mentally produce possible images of objects they were looking for. The second situation was less certain and more complicated, and we assumed that it would increase the time and affect the strategy of eye movement activity. The effects of attractiveness and familiarity of target stimuli were assessed separately as well as in correlation with the low and high-level factors.

## 2. METHOD

Sixty-two healthy volunteers took part in this experiment; 41 females and 22 males ranging in age from 18 to 48, the mean age being 22 years 3 months. Prior to the experimental sessions, an orientation and a series of trials were performed. During the experiment the participants were seated 0.65 m away from a 19-inch computer screen. They were instructed to find symbolic images of real-life objects (such as a butterfly, a cactus, a book, etc) among a variety of other objects. The pictograms were taken from the Internet and modified into the stimulus material. A total of 5128 pictures were collected, among which 32 were selected at random. Prior to the main experiment, the subjects were required to rate the familiarity and attractiveness of the symbolic images from 1 to 4. Afterwards, the average indexes of attractiveness and familiarity were estimated for each stimulus, which were divided into two groups of more and less attractive stimuli (the Attractiveness Factor) and two groups of more and less familiar ones (the Familiarity Factor).

The stimuli were arranged in rectangular full screen stimulus patterns (matrix) 9x9. It was a 1466 x 954 pixel rectangle with the resolution of 300 pixels per square inch. Each matrix contained 81 objects, one of which was the target. The target stimulus was situated in one of 8 quadrants (the central quadrant was not used). Thirty-two matrices were shown, half of which were black and white, the other half were colored (the Color Factor). The stimuli consisted of black circles or squares, in the center of which either a white or colored image of a symbolic object was placed.

In half of the cases, the target stimulus was set as a text. In the other cases, it was presented in the form of an accurate copy of the searched image but in gray (the Format of the Target Stimulus Factor). The order of the matrices presented varied from subject to subject.

We recorded the search rate and eye movement data. Eye movements were sampled monoculary at 250 Hz using SMI iView X RED 4 (FireWire) tracking system with on-line detection of saccades and fixations and a spatial accuracy < 0.5°. There were 32 trials recorded for each subject, which counted for 2016 trials altogether. The trials were calculated and subjected to factorial ANOVA (two-way ANOVA) using IBM SPSS Statistics 19.

## 3. RESULTS AND DISCUSSION

***3.1 The effects of low and high-level factors***. The results demonstrated that the target template affects the search rate and the scanning process (Table 1). If the target stimulus is set as a word, it requires a longer time period on average in comparison to a picture. This outcome was, in fact, expected. A more surprising result was the fact that the format of the stimulus could determine the search strategy, i.e. a specific eye movement pattern. In other words, the stimulus' format – a high-level factor – regulates eye movement activity. If the stimulus is presented as a word, the search query turns out to be less determined. A subject would use as a target sample not just a mental representation stored in the working memory but rather its semantic field, which could include a number of visual representations. The search in this case requires a deeper and more detailed processing of information. It leads to a longer average fixation duration, shorter-amplitude and slower saccades. This type of eye movement pattern is characteristic of focal vision. If the stimulus is set as a picture, the search query is highly accurate. The stimulus sample is a particular mental representation stored in the working memory. The subject's task is to compare it with the images he or she comes across. This does not require deep semantic processing and can be accomplished with shorter fixations and quicker saccades with longer amplitudes. This eye movement pattern is typical for ambient vision.

The target stimulus was outlined in the matrix as the area of interest (AOI) and certain eye movement data was registered around that segment. The time spent within the zone of interest (AOI dwell time) not only includes the time spent on the stimulus perception and its comparison to the sample image but also on making the final decision as to whether the searched element was indeed found. As we can see in Table 1, the average time spent in the interest zone is longer when the stimulus was set as a text, although the differences are not too profound. The more apparent differences can be observed when counting the number of eye fixations in the area of interest, which could be connected with the performed cycles of cognitive processing. This outcome can possibly imply the necessity for the subject to verify the correct stimulus in cases when the format of the search query was incongruent with the element (word vs. picture).

The assumption that the search effectiveness will differ whether the stimulus matrix is colored or black and white did not prove valid. The Color Factor turned out to be insignificant for all the measured criteria. However, some interesting results were discovered regarding the correlation between the color and frame factors with the format of stimulus. These results suggest that the stimulus format not only determines the search strategy but also affects the significance of low-level factors.

*Table 1.* The time of search and eye movement parameters in different formats of the target stimulus presented – as a word or a picture

| | All trials | The target template | | F (1, 1983) | Sig |
|---|---|---|---|---|---|
| | | word | picture | | |
| **Search Time [ms]** | **12119,808** | **13,142** | **11,091** | **11,972** | ***p*< 0,01** |
| **Fixation Duration Average [ms]** | **226,518** | **230,909** | **222,101** | **7,575** | ***p*< 0,01** |
| **Saccade Amplitude Average [°]** | **3,901** | **3,736** | **4,068** | **6,575** | ***p*< 0,01** |
| **Velocity Average [°/s]** | **108,152** | **105,107** | **111,218** | **18,008** | ***p*< 0,01** |
| **Fixation Count in AOI** | **3,480** | **3,667** | **3,287** | **7,013** | ***p*< 0,01** |
| **DwellTime in AOI [ms]** | **1745,093** | **1821,405** | **1666,006** | **4,079** | ***p*< 0,05** |

The Color Factor in itself did not appear to be important. However, its correlation with the stimulus format had an effect on the search rate. It appears that color might actually interfere when searching for the target stimulus if it is set in the form of a word and, on the contrary, serve as an aid when the stimulus is presented as an image (Fig.1).

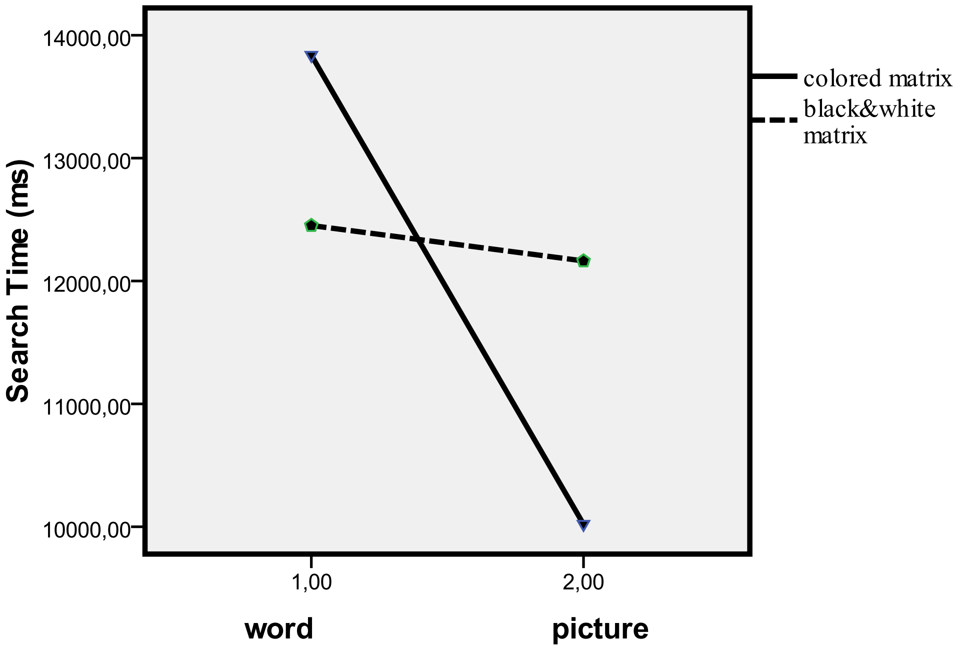


Fig.1. Search time as a function of the format and color of the stimulus matrix

While interpreting the data, it is important to consider that even when the stimulus was set as a picture it was black and white, so the color did not play a key role in detecting the searched element but rather affected the mechanisms of cognitive processing. The color grade of the stimulus provided faster cognitive processing on lower levels that are related to a mere comparison between the perceived image with the one stored in the working memory. On higher levels, when semantic analysis is involved, the color can in fact present itself as a limitation. No significant interaction was found between the two factors in relation to eye movement activity.

**3.2 The influence of the familiarity of the target stimulus on the search rate and characteristics of eye movement activity.** The results of our study have confirmed that the elements perceived as more familiar are usually found significantly more quickly. Furthermore, it was illustrated that the increase of familiarity changes the characteristics of the search process: the number of fixations and saccades as well as the length of distance covered per time unit increase (Table 2).

*Table 2.* The time of search and eye movement parameters in different levels of familiarity

| | All trials | Low-level Familiarity | High –level Familiarity | F (1, 1983) | Sig |
|---|---|---|---|---|---|
| **Search Time [ms]** | **12119,808** | **13493,057** | **10551,226** | **11,972** | ***p*< 0,01** |
| **Fixation Count** | **18,439** | **17,828** | **19,589** | **3,455** | ***P*= 0,05** |
| **Scanpath Length [px]** | **3883,5** | **3686,07** | **4255,08** | **7,003** | ***p*< 0,01** |
| **Fixation Count in AOI** | **3,480** | **3,662** | **3,274** | **7,311** | ***p*< 0,01** |
| **DwellTime in AOI [ms]** | **1745,093** | **1768,011** | **1719,154** | **0,401** | ***p*> 0,5** |

At the same time, the duration of fixations and saccade amplitudes do not vary for either levels of familiarity. The search process has a wider scope than with the less familiar stimuli. These conclusions are in line with the earlier assumptions of Q. Wang, P. Cavanagh, M. Green [1994]. They supposed that more familiar stimuli allowed subjects to use intuition in searching and decision-making processes. In these cases subjects rely on a sudden (pop out) spotting of a searched stimulus.

A prominent correlation was observed between the level of the target stimulus' familiarity and its presentation format in regards to the search rate index (Fig. 4). As we presumed, the familiarity was more important in the situations when the target stimulus was set as a text. When it is set as a picture, its representation is stored in the working memory. In this case, its general long-term familiarity does not play an important role. However, when searching for a stimulus presented as a word, the subject has to compare new elements with the information stored in the long-term memory. In such instances, familiarity (i.e. the past experience of interaction with the stimulus) can play a crucial role. In addition, no interaction between color and familiarity was observed.

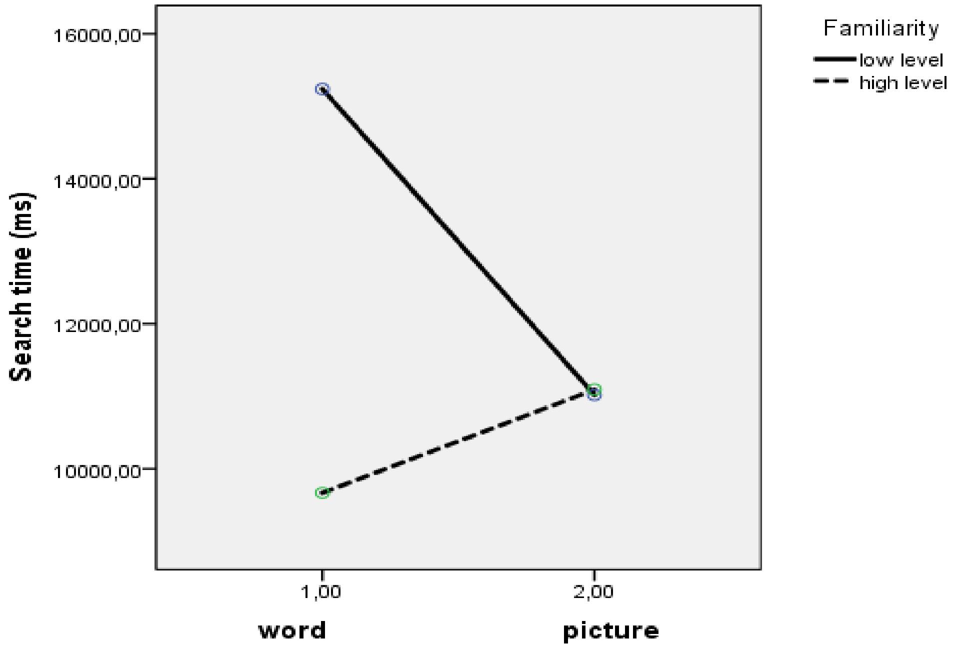


*Fig. 2.* Search time as a function of familiarity and target presentation format

**3.3. The effects of stimulus attractiveness on the search time and eye movement activity.** Somewhat weaker effects were registered for the factor of attractiveness. It is not particularly odd since the estimates of attractiveness are highly individual and can be characterized by a wide range of results. In general, it appeared that the attractiveness can lengthen the search rate and time spent in the zone of interest (Table 3).

*Table 2.* The time of search and eye movement parameters in different levels of_attractiveness

| | All trials | Low-level Attractiveness | High –level Attractiveness | F (1, 1983) | Sig |
|---|---|---|---|---|---|
| **Search Time [ms]** | **12119,808** | **11227,557** | **13047,990** | **6,016** | ***p*==0,01** |
| **Fixation Duration Average [ms]** | **226,518** | **223,450** | **229,698** | **6,988** | ***p*< 0,01** |
| **DwellTime [ms]** | **1745,093** | **1566,793** | **1937,741** | **13,317** | ***p*< 0,01** |

The attractiveness of the target stimulus can make subjects fixate their attention on the target and become distracted. It also corresponds with the lack of data that can be found in scientific literature. Particularly, in the study by Salimun, Purchase, and Simmons [2012], it was demonstrated that subjective attractiveness can lead to longer search rates and increase the number of errors.

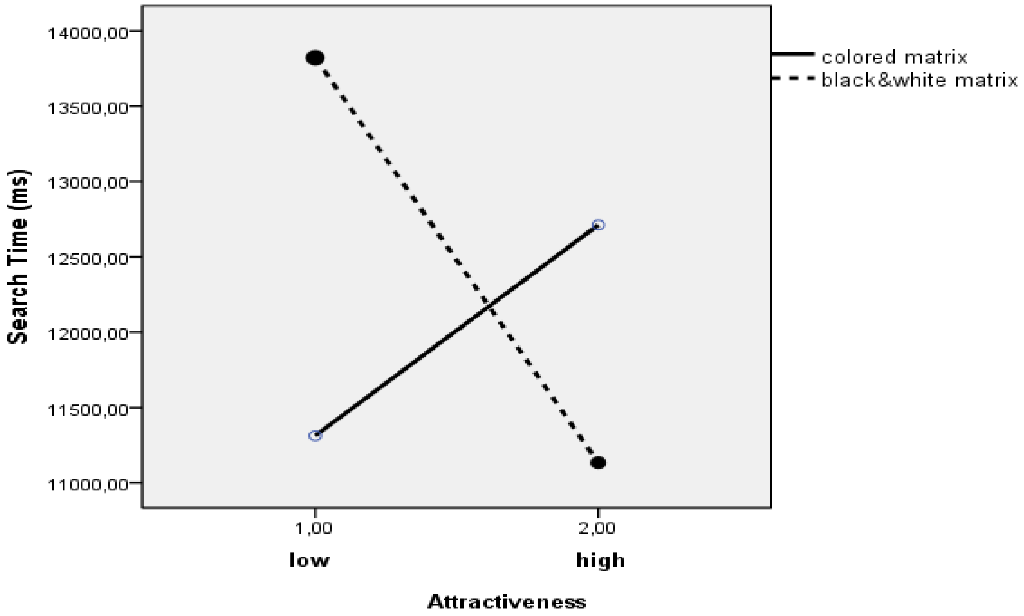


Fig. 3. Search time as a function of attractiveness and the color grade of the stimulus matrix.

As we predicted, a relevant correlation between the factor of attractiveness and the color factor was found in terms of search rate (Fig. 3). In colored stimulus matrices, searching for attractive stimuli takes longer than in black and white matrix. It gives evidence to the fact that the color factor is related to and contributes to attractiveness. We did, however, assume that the attractiveness of the target stimulus would have a stronger effect for the stimuli represented as images, but that assumption was not verified. Likewise, we did not see a particular correlation between the factors of attractiveness and familiarity.

## 4. CONCLUSION

Searching for target objects in real or virtual surroundings is one of the most important life tasks. In order to succeed, one has to set the right direction or select the right segment of the environment while disregarding everything that is not related to the target before its detection and then, finally, confirming the accuracy of his or her choice. It is necessary to possess a more or less clear representation (or description) of the searched object to be able to compare it with the perceived information. The results of our empirical analysis showed that the target template has a big impact on the effectiveness of the search process as well as the manner of scanning the environment. It was discovered that a textually set target stimulus requires a longer time period to be found. Moreover, the nature of cognitive processing changes – longer fixations occur, including slower saccades with shorter amplitudes. A pattern of eye movement of this kind indicates deeper information processing that reaches the level of semantics.

It appeared that the color grade of a stimulus, as a low-level factor, does not play a significant role on its own, although it interacts with other factors. It was illustrated that the color grade helps the subject to detect the target stimulus within a matrix when it is set in the form of a picture and, on the contrary, can hinder the search process when it is presented as a word. This knowledge suggests that the format the target stimuli are presented in affects the search process as well as determines the role of lower-level factors. If the target stimulus is presented as a picture, the search is conducted through surface-level cognitive processing. At this level, the various physical features of the matrix can play an important role – in particular, the facilitating effects of the color grade become more apparent. If the target stimulus is set as a word, its search and detection requires a deeper semantic analysis. In this case, the role of the physical characteristics is the reverse. What made it easier to detect the target object at the surface-level of processing now has a negative effect.

The role of subjectivity was also described. We were able to see that the familiarity of the stimuli speeds the search process and makes it wider. Notably, more familiar objects could be found more quickly when set as words. However, when the target was set as an image, its familiarity did not make a difference. The attractiveness of the stimulus had the opposite effect – it slowed down the process. Furthermore, the factor of attractiveness correlated with the color factor as a low-level factor but did not have any connection with the high-level factors.

The resulting data could be applied in the area of interface development. In particular, it is important to take into account the type of search query and task that a user will potentially come across. When dealing with visual search, it is essential to keep in mind the habitual format of a search query. Since a web page user's task is formulated verbally in most cases, the developers should cautiously apply tools that can increase the esthetic and emotional value of the interface and its elements. It is also wise to limit the variety of graphic elements where diversity could in fact decrease subjective familiarity and, thus, decrease the effectiveness of the search.

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# ITHEA IJ AND IBS SAMPLE SHEET FOR PREPARING THE MANUSCRIPTS

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***Abstract**: The rules for preparing the manuscripts for the International Journals (IJ) and International Book Series (IBS) of the ITHEA International Scientific Society (ITHEA ISS) are outlined. The form for the papers is shown by this sheet. An extended up to one page abstract in the same form needs to be submitted separately.*

***Keywords**: formatting rules (Keywords are your own designated keywords).*

***ACM Classification Keywords**: A.0 General Literature - Conference proceedings (This is just an example, please use the correct category and subject descriptors for your submission. The ACM Computing Classification Scheme: http://www.acm.org/class/1998/. For instance see http://wiki.ithea.org/ )*

***Conference topic**: Every paper submitted to be published by ITHEA ISS need to be presented at any of the ITHEA International Conferences. Please point here the right topic of the chosen ITHEA International Conference where the paper will be presented (topics are available on the corresponded conference web-page accessible via http://www.ithea.org or http://www.foibg.com ).*

## Introduction

We ask authors to follow some simple guidelines.

*In essence, we ask authors to make papers look exactly like this document.*

This text is a sample for preparing the manuscripts for publishing in ITHEA ISS International Journals and Book Series. All styles needed for formatting the papers are included.

The easiest way to prepare your manuscript in accordance of these rules is simply to replace the content of this sample sheet with your own material.

Responsibility for papers published in ITHEA International Journals and Book Series belongs to authors.

Please *get permission to reprint* any copyrighted material.

The camera-ready copy of the paper should be received by the ITHEA Journal Submission System ( http://ij.ithea.org ) or respectively by the ITHEA Conference Submission System ( http://ita.ithea.org ); e-mail for questions: info@foibg.com.

## Instructions for Preparation of Manuscripts

The authors are hoped to prepare manuscripts in close accordance with the instructions given below.

This text is a sample for preparing the articles. All styles needed for formatting the papers are included. Do not include any new styles. Please, *do not use automatic numbering anyway*, because of losing the information during the assembling the journals or books.

**Name the file** of the manuscript beginning with the journal or conference name, following with the family names of the authors or if they are more than 2 authors – name of the first author, followed by "_et_al".

For instance if the manuscript will be submitted to:

- IJ ITK 2010 from Markov and Mitov, than the file needs to be named: "**IJITK10-Markov_Mitov.doc**" ;
- IJ ITA 2010 from Markov, Ivanova, and Mitov, than the file needs to be named: "**IJITA10-Markov_et_al.doc**";
- i.TECH 2010 from Markov and Mitov, than the file needs to be named: "**iTECH10-Markov_Mitov.doc**";
- i.TECH 2010 from Markov, Ivanova, and Mitov, than the file needs to be named: " **iTECH10-Markov_et_al.doc**".

Accepted manuscripts will be published as follow:

- surveys from 12 up to 20 pages will be published in the International Journal "Information Theories and Applications"® (IJ ITA) or International Journal "Information Technologies and Knowledge"® (IJ ITK);

- regular papers from 4 up to 12 pages will be published in specialized thematically organized collections in the International Book Series "Information Science and Computing" (IBS ISC);

- papers less than 4 pages will be assumed as extended abstracts and will be published in the ITHEA ISS International Review Journal “Information Research and Engineering”;

- books or specialized thematically organized collections will be published in the International Book Series "Information Science and Computing" (IBS ISC).

Manuscripts must be submitted within the stipulated time and electronic submission in DOC, DOCX or RTF formats is required.

Manuscripts will be evaluated for originality, significance, clarity, and soundness, and will be reviewed by at least two independent reviewers.

The authors of the accepted manuscripts will be allowed to make a correction in accordance with the suggestions of the reviewers and to submit final camera-ready manuscripts within the stipulated deadline.

The papers should be organized so as to accommodate abstract, introduction, state-of-the-art, objective, used methodology, obtained results and comparing them with similar results in the world, and references.

Format of the pages is **A4** paper (210 x 297mm).

**Margins** of the paper sheet are: top - 30mm; bottom, left, right - 25mm.

**Typing styles:** The paper should begin with the title of the paper (use the style "**Title**") and the name(s) of the author(s), (use the style "Authors"). Please, write the whole ***first name and family*** of the authors.

After that apply style "**Abstract**" for: "Abstract", "Keywords" and "ACM Classification Keywords". Papers should contain up to 5 keywords.

The abstract needs to be from 200 to 500 words long. An extended up to one page abstract needs to be submitted separately.

Note that the abstract is very important for:

- directing the paper to the right reviewers;
- including the paper in the right section of the journals or collection in the book series;
- representing the paper in the ITHEA International Review Journal.

Use "**Normal**" style - Arial Narrow; 11pt; 1.2-spaced text; 3pt before each paragraph; without special indents; left and right justification.

Use style "**Subtitle**" for the titles of the separated parts of the article.

**The papers need to be well structured**. This means that "Introduction", "Conclusion", "Acknowledgements", "Bibliography" and "Author's Information" need to be separated clearly. The body of the paper needs to be organized in different parts named using style "Subtitle".

**Figures and tables** should be positioned in the body of the text, as close as possible to the relevant text. ***Number manually*** all figures and tables. Use these numbers to point them in the text. Note that the position of figures and tables may be changed during the assembling the journals or books. Color figures are good for electronic variant but they will be printed in grayscale and some colors may look as equal.

**Formulas** should be positioned in the body of the text, as close as possible to the relevant text. Put formula and its number in a table row without borders. Align the formula to the center and its number to the right as follow:

$$D = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \qquad (1)$$

The MathType INI v1: Equation Preferences ( given in ITHEA.eqp ) are:

[Styles]
Text=Arial
Function=Arial
Variable=Arial,I
LCGreek=Symbol,I
UCGreek=Symbol
Symbol=Symbol
Vector=Times New Roman,B
Number=Times New Roman
User1=Arial Narrow
User2=Arial Narrow
MTExtra=MT Extra

[Sizes]
Full=11 pt
Script=58 %
ScriptScript=42 %
Symbol=150 %
SubSymbol=100 %
User1=75 %
User2=150 %
SmallLargeIncr=1 pt

[Spacing]
LineSpacing=150 %
MatrixRowSpacing=150 %
MatrixColSpacing=100 %
SuperscriptHeight=45 %
SubscriptDepth=25 %
SubSupGap=8 %
LimHeight=25 %
LimDepth=100 %
LimLineSpacing=100 %
NumerHeight=35 %
DenomDepth=100 %
FractBarOver=8 %
FractBarThick=5 %
SubFractBarThick=2.5 %
FractGap=8 %
FenceOver=8 %
OperSpacing=100 %
NonOperSpacing=100 %
CharWidth=0 %
MinGap=8 %
VertRadGap=17 %
HorizRadGap=8 %
RadWidth=100 %
EmbellGap=12.5 %
PrimeHeight=45 %
BoxStrokeThick=5 %
StikeThruThick=5 %
MatrixLineThick=5 %
RadStrokeThick=5 %
HorizFenceGap=10 %

**References** in the text should be keyed with the name(s) and year of the referred material - for instance [Shannon, 1949].

Put list of **bibliography** after the text of the article using the style "**Bibliography**".

**Author's Information:** Finish the article with the personal information for every author separately: photo, name of the author, position, organization(s), post and e-mail address(es), major fields of scientific research (keywords). For this information use style "**Normal-Authors**".

Note that the only way to contact the authors is pointed e-mail address in the author's information. Be sure that the addresses are written correctly. If you (or your internet provider) use anti-spam protector write the way to access the e-mail address.

## Conclusion

This exemplar is meant to be a model for manuscript format. Please make your manuscript look as much like this exemplar as possible. In case of serious deviations from the format, the paper will be returned for reformatting.

*NOTE: Every manuscript submitted to be published by ITHEA ISS need to be presented by author(s) personally at any of the ITHEA International Conferences.*

Papers from members of the ITHEA International Scientific Society (ITHEA ISS) will be published preferably. Membership of ITHEA ISS is free and may be done by registration at the www.ithea.org and www.foibg.com. Submitted manuscripts should be original and should contain contributions of theoretical, experimental or application nature, or be unique experience reports.

## Bibliography

[Shannon, 1949] C.E.Shannon. The Mathematical theory of communication. In: The Mathematical Theory of Communication. Ed. C.E.Shannon and W.Weaver. University of Illinois Press, Urbana, 1949.

## Authors' Information

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*Major Fields of Scientific Research: General theoretical information research, Multi-dimensional information systems*