Cognitive analysis of information perception through images*

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Abstract

This article examines the perception of information through images in visual design, focusing on the cognitive and aesthetic aspects of the impact of visual elements on users. It analyzes how the form, color, organization, and context of images affect the ease of perception, memorization, and interpretation of information. The article also examines effective visual design principles that facilitate the perception of content, such as infographics, iconography, and minimalist composition. Examples of different types of images are given and recommendations for using visual strategies to increase the clarity and attractiveness of information perception are provided. The results of the study emphasize the importance of a harmonious combination of aesthetics and functionality in visual design to improve user experience and effective presentation of information. The study used the expert evaluation method to identify and analyze image usability criteria. The pairwise comparison method was used to obtain the rank values of the selected usability criteria. Based on the results obtained, the weight and importance of each criterion compared to other criteria were determined. The most weight was given to the context-dependent criterion, the least to the composition criterion. The conclusions provide suggestions and recommendations on various image plans and their specific content. And from the point of view of their application, the importance of careful and balanced use of images in visual design is shown to achieve maximum effectiveness and attract the target audience.

Keywords

information, cognitive analysis, image, design, interface, visualization, expert evaluation method, pairwise comparison method [1]

1. Introduction

Interface design is not just about layout, organization, and even editing. Today, interface design means providing value and meaning, bringing clarity, simplifying, explaining, reframing, attracting attention, persuading, and, in some cases, entertaining. For example, when we browse a website, we immediately understand whether it is pleasing to the eye or not. Consciously or unconsciously, we evaluate the interface that a company provides us. However, we rarely think about what makes a design attractive. In technical terms, visual design is what users see on a website or other platform. Its main task is to improve the aesthetics of a design or product and make it user-friendly through the use of appropriate images, icons, and typography.

However, it is worth noting that visual design is a broader and more global concept than aesthetics. Ultimately, designers must carefully monitor the placement of elements and the attractiveness of platforms in order to create an optimized, useful, high-quality and beautiful interface.

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In today's world of content marketing, the main goal of visual design is to capture the attention of the audience and keep it for as long as possible.

One of the key roles of interfaces is interaction. Interfaces can illuminate, explain, activate, reflect relationships, connect or separate people, manage expectations, and provide access to services. The process of designing an interface is not an art. Interfaces are not architectural monuments in themselves, but the fact that they perform certain tasks and their effectiveness can be measured. However, they can have more than just a purely practical application. The best interfaces are those that inspire, evoke emotions, surprise, and enhance the perception of the world.

2. Literature review and problem statement

In the scientific literature, the problem of perception of information through images is considered from different points of view: psychological, aesthetic, cognitive and communicative. Researchers emphasize that images can significantly improve the understanding, perception and memorization of information due to the peculiarities of human vision and thinking. Scientific studies show that visual information is processed by the brain faster than written information. According to research in the field of cognitive psychology, dual codes (text + image) contribute to more effective memorization, as they activate verbal and non-verbal memory mechanisms.

Media studies show that visual elements (graphs, illustrations, infographics) simplify complex information and make it more accessible and engaging for different audiences. Visual communication plays an important role in creating intuitive digital interfaces, marketing materials, and educational resources.

Thus, in their work [1], the authors paid attention to the issue of the value of visual perception by balancing the relationship between attractiveness and cognitive perception, which ultimately will help improve the quality of the visual environment. Experiments showed that when the spatial visual complexity was below a certain value, attractiveness was greater than cognitive load with advantages in spatial perception. At the same time, when the complexity exceeded a given number, cognitive load exceeded attractiveness, without advantages in spatial perception.

In [2], the authors of the study examined the question of which information is better perceived from food labels – in digital form or in the form of an image. The results obtained confirm the data that people, as a rule, process information better in the form of an image than in numbers. As the authors note in the work, the better perception of visual images compared to digital ones occurs mainly due to the activation of images created in our thinking.

Based on recent research in the field of visualization, the authors of the article [3] summarize the current work on immersive visualization from the perspective of multimodal perception and interaction in immersive environments. In addition, the paper discusses the problems and trends in the development of immersive multimodal perception and interaction methods, and explores potential areas for the development of immersive visualization design directions.

The issue of the difference between random visualization and regular visualization is considered in the work of the authors [4]. It is noted that random visualization differs from regular visualization in that it is not the main focus of a person’s attention and is not embedded in the environment in which a person is. This topic, as the authors note, is new in modern research. To clarify the role of this type of visualization, the authors conducted a study showing participants random visualization during the performance of the main task. The conclusions obtained from the results of this study showed that random visualizations effectively convey information without disrupting the main task, but working memory limitations should also be taken into account.

The results of the study [5] show that visualization usually induces the phantom effect. The study also found that anticipation helps to mitigate this effect. Although the results did not provide numerical values, they suggest that visual working memory and visualization literacy play a role in bias susceptibility. As the authors of the study note, these results are the first steps towards

understanding the role of individual differences in susceptibility to cognitive biases in visualization contexts.

In their work [6], the authors note that scientists usually use a wide range of colors to demonstrate their research results. The authors point out that this use not only distorts the perception of the data obtained, but is also inaccessible to a part of the population. This is due to the fact that certain colors are highlighted over others, which distorts the perception of the data. Data should be provided without distortion and be publicly available. The authors make their assumptions in the use of the color scheme and invite discussion of this issue.

Quite interesting, in our opinion, is the study of the authors [7], which concerns the use of biophilic design in visualization. As the authors note, the connection of man with nature should be a key component in creating comfortable and favorable conditions indoors. Preliminary results indicate the effective impact of this design on human performance. The results of cognitive tests showed that audiovisual connection with nature can positively affect working memory and the efficiency of task switching. But it is also noted that the acoustic factor demonstrated a higher effect compared to the visual factor.

In [8], the authors compared the differences in human perception of dynamic and static images. The results of the experiment show that the visual cognitive effect was better for dynamic images than for static images. However, the emotional impression of viewing dynamic images was significantly affected by the time of presentation. This study, as the authors note, is the basis for developers and advertisers to improve the viewing and presentation of the proposed products.

The issue of interior design and room design is presented in [9]. These studies were conducted on people who differ in gender and age. They were asked to evaluate various rooms by size and design. As the study showed, natural biophilia was the most influential. Images were selected with high brightness and natural biophilia. This study provides an in-depth understanding of the complex multimodal interactions between interior design elements and personality aspects, as well as meaningful ideas for space planning.

The authors of the study [10] note that in the context of the modern information explosion, how to extract useful information from a large amount of image data and transmit it to users is a complex problem. The study aimed to achieve effective image data exchange by building a sensor network simulation and using visual feature extraction methods. As a result, a sensor network simulation was built to imitate the principle of operation of a biosensor system, which achieved the perception and understanding of the data carried by the image, as well as automatic acquisition and processing of information from input images. Research on the use of visual feature extraction methods to extract features that describe the content and structure of images, and apply them to the results obtained as a result of sensor network simulation, to accurately capture important information in image data. The research aims to convey the extracted feature information to users through visual means and present the extracted feature information to users in an intuitive graphical form, so as to gain a more intuitive understanding of the meaning and characteristics of image data, improve the ability to understand the data and analyze the results. This method provides a new solution for the field of image visualization data transmission, which helps to improve the efficiency and accuracy of data transmission.

As can be seen from the above review of modern scientific literature, we have not found any answer to the question of which images are better perceived by humans and in which situations. In our opinion, this issue is poorly researched and requires more attention in understanding.

3. Basics of the proposed research methodology

Our study proposed using the expert assessment method and the paired comparison or hierarchical analysis method. The expert assessment method is a method of forecasting and evaluating future behavioral outcomes based on expert forecasts. Our study proposed using the expert assessment method and the paired comparison or hierarchical analysis method. The expert assessment method is a method of forecasting and evaluating future behavioral outcomes based on expert forecasts.

When using the expert assessment method, a special group of experts is surveyed to identify specific variables necessary for assessing the issue under study. A prerequisite for the effective use of the expert assessment method is sufficient knowledge of the issue under study, a high degree of erudition, and the ability to give clear and comprehensive answers, including improvised ones. In addition, experts should not be interested in a specific solution to the problem. Experts are selected based on their official professional status, such as position, academic degree, or work experience. This selection ensures that the expert has a high level of specialization and extensive practical experience in the field. Among the experts who participated in our survey were ten specialists working in the IT industry with over 5 years of experience in UX/UI design [11, 18].

In practice, the expert assessment method is a forecasting method, the main criterion of which is to reach a consensus among all members of the expert group. Organizationally, it looks like this. Experts with knowledge in related fields answer detailed questions in a questionnaire concerning the issue under study. Each expert records their opinion on the issue and shares their answers with colleagues. If their expectations differ from the opinions of others, the expert must explain why. The procedure is then repeated until the experts reach a consensus. In this case, anonymity is necessary to avoid the possibility of collective reflection on the problem situation.

One method of group expert assessment is the Delphi method [12, 13], in which a group of experts conducts several expert surveys (often three or four times) to select the best solution. The Delphi method, also known as the Delphi technique or the Delphi oracle method, comes from the name of the ancient Greek city of Delphi, where the oracle lived in the temple of Apollo. The words of the chief oracle were accepted as indisputable and true.

The goal of the Delphi method is to improve the group approach to forecasting and assessment by mutually critiquing the opinions of individual experts without direct contact between them and while maintaining the anonymity and protection of opinions.

Decision-making theories and methods are typically used in conditions of uncertainty, i.e., when there is incomplete information about a situation, phenomenon, or object model, and decision-making involves the risk of making the wrong decision. Decision-making is understood as a specific process of human activity aimed at choosing the best option from among possible actions.

Consequence analysis plays an important role in decision-making. Most decisions made by humans do not allow for accurate calculation and assessment of consequences. One can only assume that a particular decision will lead to a certain result. Of course, such assumptions may turn out to be wrong. This is because it is not always possible to take into account all the factors that influence the outcome of a decision. However, although computers are not as fast and accurate in their calculations, humans have the unique ability to quickly assess a situation, identify the main points, discard the secondary ones, compare conflicting assessments, and fill in the gaps with their own assumptions. This calls into question the need to create tools to help humans make decisions.

In the decision-making process, the decision-maker makes a conscious choice between several alternatives (e.g., plans, options, or methods, depending on the context). In making this choice, the decision-maker seeks to achieve a specific goal while taking responsibility for the consequences of their decision. Decision makers can be individuals or groups.

The use of decision-making methods involves constructing an appropriate model that can formally represent the problem situation, i.e., the decision-making situation. The elements of such a model are a set of all alternatives from which the decision-maker chooses the best one. In order to ensure freedom of choice, the set of alternative decisions must contain at least two elements. There are currently many classifications of decision-making methods based on the use of different attributes. For the most part, decision-making methods are divided into two groups: methods for decision-making under conditions of certainty and methods for decision-making under conditions of uncertainty. Of the many well-known methods and approaches to decision-making, the most interesting are those that allow for multi-criteria and uncertainty and enable the selection of decisions from different types of sets of alternatives when criteria with different types of measurement scales are available.

The most promising methods for decision-making under uncertainty are the methods of decomposition of expected utility theory, hierarchical analysis methods, and fuzzy set theory. This choice is due to the fact that these methods meet the requirements of universality, consideration of multi-criteria selection in conditions of uncertainty from a set of discrete or continuous alternatives, simplicity of preparation, and maximum simplicity of processing expert information.

The T. Saaty hierarchy analysis method was proposed by American mathematician T. Saaty in the late 1970s. This method breaks down a specific problem into simpler components and gradually prioritizes them by evaluating them using pairwise comparisons. The hierarchy analysis method covers the procedure of synthesizing a set of judgments, prioritizing criteria, and searching for alternative solutions [14, 15]. An important advantage of this method is that it provides a clear description of the judgments of experts and decision-makers, as well as a clear understanding of the structure of the problem—the complex elements of the problem and the interdependencies between them. Complexity is characterized by numerous interactions between subjective and objective factors of various types and importance, as well as between groups of people with different goals and conflicting interests. These situations determine the probability of choosing one of the alternatives without a certain compromise. Problem solving using hierarchical analysis is a step-by-step process of prioritization. It includes the following elements: defining and identifying the problem; decomposing the problem into a hierarchy of tasks; identifying criteria for evaluating task solutions; constructing matrices of pairwise comparisons of criteria; calculating priorities; synthesizing priorities; checking consistency.

Completing these steps within the framework of the hierarchical analysis method makes it possible to obtain an objective quantitative assessment of the weights of all elements of the hierarchical structure that are relevant to the problem. This method involves constructing a matrix of pairwise comparisons. The priority matrix is determined by comparing the elements of each hierarchy with each other. In the hierarchical analysis method, elements are compared in pairs depending on their impact on overall characteristics. The resulting matrix is positive and inversely symmetric. If the phenomenon being compared is one for which a specific measurement system is provided (e.g., assessment of weight, length, distance), the actual relationships between the measured values are entered as relationships between table elements. In the case of qualitative assessments (e.g., comparison of criteria), pairwise comparisons can be made using judgments about the relative importance of components. These judgments are expressed quantitatively using a specially developed scale of relative importance: the Saaty method recommends a special scale from 1 to 9, according to which components of equal importance are assigned 1, weak significance - 3, significant advantage - 5, strong advantage - 7, absolute advantage - 9. At the same time, the values 2, 4, 6, and 8 are used as intermediate values between two adjacent components that have received ratings of 1, 3, 5, and 7, respectively [16].

The relative importance of any element compared to itself is equal to one, i.e., the diagonal of the matrix consists of ones. When filling in the matrix, the property of reverse symmetry is used: symmetrical cells are filled with reverse values.In order for numerical comparisons to be valid, no more than 7–9 elements should be compared. If there are more than 7–9 elements to be compared at the same level, hierarchical decomposition must be performed. The elements are grouped, and classes of 7–9 elements in each are compared.

4. Research results

When testing the usability of images, it is important to evaluate various aspects that affect users' perception and interaction with these images. Let's analyze the criteria for image usability testing: perception – users should easily perceive the image and understand its content; the image should be clear and vivid enough; effectiveness – the image should achieve its goal; for example, if it is a link image, users should be able to click on it correctly; emotional response – it is important to assess how the image affects the emotional state of users, does it evoke positive or negative emotions?; context dependence – the image should correspond to the context in which it is used,

for example, images on a page about children should be relevant to this topic; color and contrast – colors in the image should be chosen with accessibility and clarity in mind, and there should be sufficient contrast between objects in the image; loading and display speed – in web design, images should load quickly so as not to slow down users; composition – the arrangement and placement of objects in the image should be logical and aesthetically pleasing; Size and scalability – images should be the optimal size for display on different devices and scalable without loss of quality. Captions and tooltips – if necessary, images should be accompanied by captions or tooltips to explain their meaning. Brand identity – images should be consistent with the brand identity if this is important for the project.

These criteria help ensure that images meet user needs and achieve specific project goals. They can be adapted and expanded depending on the specific context and testing tasks.

4.1. Conducting an expert survey

So, let's assess the impact of images on the perception of information in visual design. We will conduct an expert survey on the extent to which different types of images in visual design meet the requirements of perception, emotional response, context dependence, color and contrast, and composition (using a 5-point rating scale). Table 1 is filled in by the expert.

Table 1
Results of expert analysis

Requirements	Image			
	photographs	illustrations	pictograms	visualization
perception	5	2	4	3
emotional reaction	3	5	2	4
context-dependent	2	4	5	3
color and contrast	5	4	2	3
composition	2	5	3	4

Based on the results of the experts analysis, summary Table 2 was completed regarding the perception requirement.

Table 2
Expert evaluation of images based on the criterion of "perception"

Image	Experts							
	1	2	3	4	5	6	…	N
photographs	5	2	4	4	3	4		3
illustrations	3	5	3	4	3	4		4
pictograms	2	4	5	3	5	4		3
visualization	5	4	2	4	3	4		3

Let us construct a graph (Figure 1) showing of the experts' assessments according to the “perception” criterion.

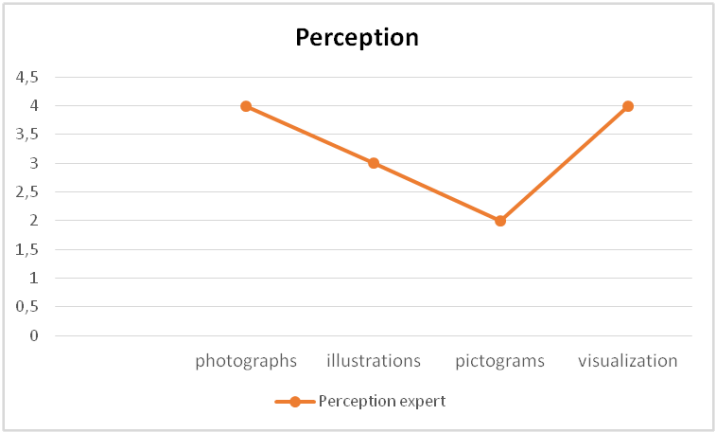

Figure 1: A visualization that clearly shows the ratings of experts based on the criterion of "perception".

We continue our research. Based on the results of expert analysis, we have completed summary Table 3 regarding the criterion of “emotional response.”

Table 3
Expert evaluation of images based on the criterion of "emotional reaction"

Image	Experts							
	1	2	3	4	5	6	…	N
photographs	5	4	3	4	3	4		4
illustrations	3	5	4	5	3	5		5
pictograms	2	3	5	3	5	4		3
visualization	5	2	2	2	3	2		2

We build a graph (Figure 2), which displays the assessments of experts.

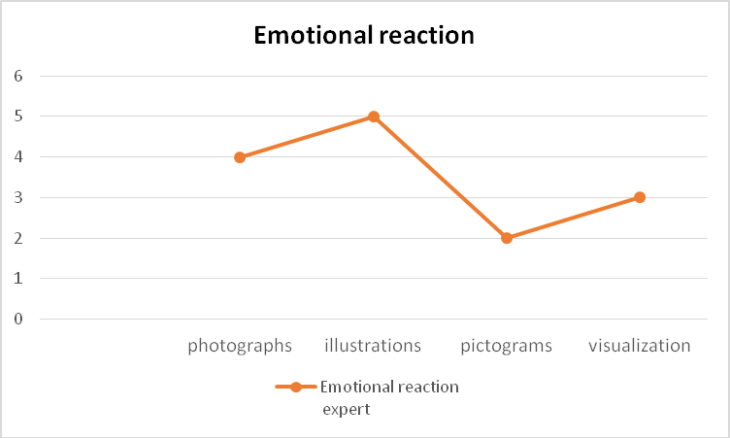

Figure 2: A visualization that clearly shows the ratings of experts according to the criterion "emotional reaction".

Based on the results of the expert analysis, summary Table 4 was completed regarding the criterion of context dependence.

Table 4
Expert evaluation of images using the “context-dependent” criterion

Image	Experts							
	1	2	3	4	5	6	…	N
photographs	2	4	3	3	3	4		5
illustrations	3	5	4	5	3	5		4
pictograms	4	3	5	4	5	4		3
visualization	5	2	2	2	3	2		2

We construct a graph (Figure 3) showing of the experts' assessments according to the criterion “dependence on context.”

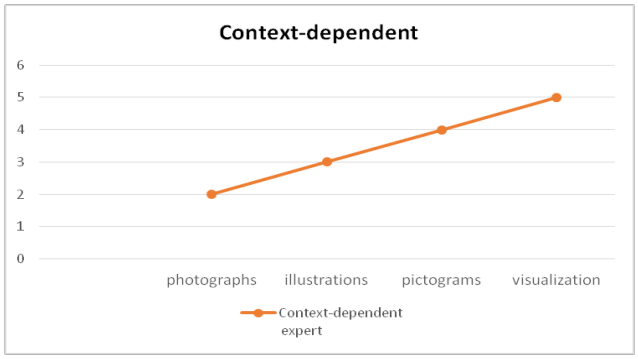

Figure 3: A visualization that clearly shows of experts ratings based on the "context-dependent" criterion.

Based on the results of the expert analysis, summary Table 5 was completed for the criterion “color and contrast.”

Table 5
Expert evaluation of images based on the criterion of "color and contrast"

Image	Experts							
	1	2	3	4	5	6	…	N
photographs	2	5	3	3	3	3		3
illustrations	3	4	4	5	3	5		4
pictograms	4	3	5	4	5	4		5
visualization	5	2	2	2	3	2		2

We construct a graph (Figure 4) showing the experts' assessments for this criterion.

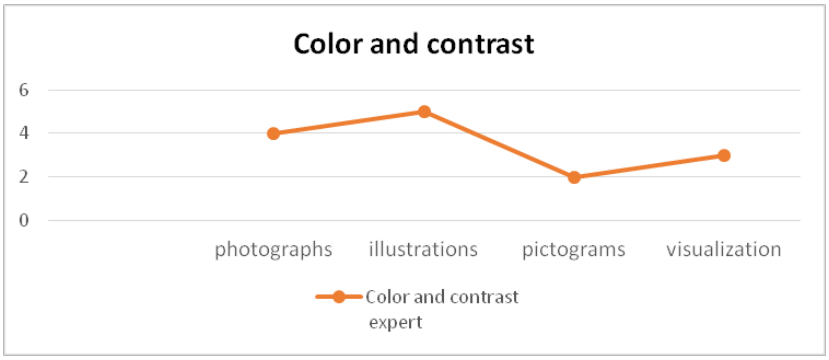

Figure 4: A visualization that clearly shows the ratings of experts based on the criterion "color and contrast".

Based on the results of the experts analysis, summary Table 6 was completed for the “composition” criterion.

Table 6
Expert evaluation of images based on the criterion of "composition"

Image	Experts							
	1	2	3	4	5	6	…	N
photographs	2	4	3	3	3	4		5
illustrations	3	5	4	5	3	5		4
pictograms	4	3	5	4	5	4		3
visualization	5	2	2	2	3	2		2

We construct a graph (Figure 5) showing the experts' assessments for this criterion.

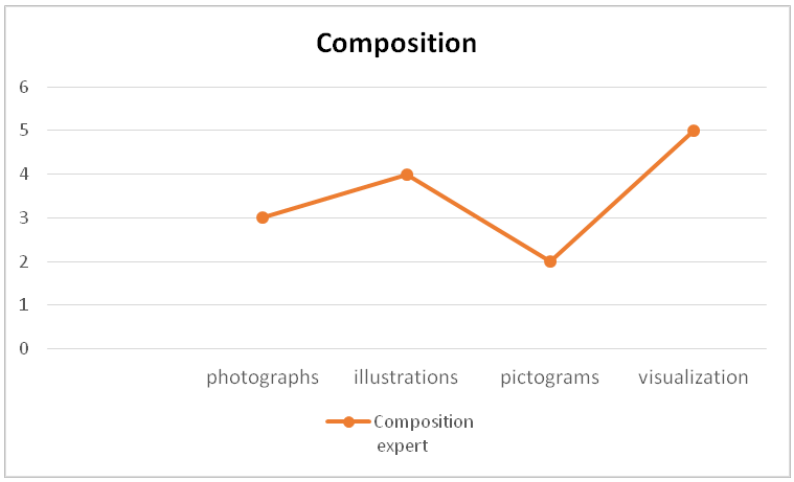

Figure 5: A visualization that clearly shows the evaluations of experts according to the "composition" criterion.

4.2. Application of the pairwise comparison method

Using the pairwise comparison method, we will conduct a criteria analysis. This method, also known as hierarchy analysis, is used in decision-making and other areas where it is necessary to compare alternatives in terms of their importance or advantages. This technique helps to rank or select options based on their relative importance. First, we will make a list of all the alternatives (image features) that we need to compare or rank. For convenience, we will give them certain designations: h_1 - perception; h_2 - emotional response; h_3 - dependence on context; h_4 - color and contrast; h_5 – composition.

For each pair of characteristics (criteria), we will compare the characteristics that are key to the decision. Next, we will determine the weight or significance of each characteristic or criterion in comparison with others. For each alternative, total scores (Table 7) are calculated based on the results of pairwise comparisons and weighting coefficients using the method described above.

Table 7
Total scores and ranks of alternatives

Criteria	Experts										Σ	Σ^2	Rank
	1	2	3	4	5	6	7	8	9	10			
h_1	6	6	7	6	5	7	5	6	7	5	60	3600	25
h_2	2	3	3	5	3	2	5	2	4	4	33	1089	43
h_3	1	5	1	4	5	1	2	2	2	3	26	676	52
h_4	2	4	3	3	4	3	4	4	2	2	31	961	34
h_5	6	7	6	8	6	8	6	7	6	5	61	3721	17
										Sum	211	10047	

To assess the consistency between experts, we will use the concordance coefficient. The concordance coefficient is a statistical indicator used to measure the degree of agreement or

concordance between evaluators who determine categories for the same object. It takes values from 0 to 1, where 0 means no agreement and 1 means complete agreement.

The concordance coefficient is often used to assess the reliability of expert assessments. For example, it can be used to assess how well different experts agree in their assessments of product quality, marketing campaign effectiveness, or scientific research results.

This coefficient takes into account random concordance that may arise as a result of random selection of categories. The main idea is to measure the degree of agreement that exceeds random agreement.

The concordance coefficient is calculated by the formula:

$$K = \frac{12\,xS}{m^2\left(n^3 - n\right)}, \tag{1}$$

where K - concordance coefficient; S - average sum of ranks; m - number of experts; n - number of evaluated factors.

$$S = \sum_{j=1}^{n}\left(\sum_{i=1}^{m} x_{ij} - \frac{1}{2}m\left(n+1\right)^2\right), \tag{2}$$

Taking the data from Table 7, we calculate the concordance coefficient:

$$S = 10047 - \frac{258^2}{9} = 10\,047 - 4946 = 5101,$$

$$K = \frac{12 \times 7779}{10^2\left(9^3 - 9\right)} = \frac{61212}{72900} - 0{,}9.$$

The obtained value of the concordance coefficient indicates the proper consistency of expert assessments.

To compare the consistency of expert judgments, we will use a matrix of pairwise comparisons and a consistency index. Therefore, to determine the numerical weight of the relevant criteria, it is necessary to construct a matrix of pairwise comparisons $A=(a_{ij})$, which is inversely symmetric and corresponds to the ratio $a_{ij}=1/a_{ji}$. When performing the assessment, the expert determines the extent to which one criterion prevails over another. To do this, they use the Saati scale of relative importance of objects, which was mentioned above [16].

The pairwise comparison matrix (Table 8) allows pairwise comparisons of elements at each level of the hierarchical structure. This method makes it possible to assess the importance of factors at different levels of the hierarchy.

Table 8

Pairwise comparison matrix

		1	2	3	4	5
		h_1	h_2	h_3	h_4	h_5
1	h_1	1	3	2	3	3
2	h_2	1/3	1	3	5	4
3	h_3	1/2	1/3	1	3	3
4	h_4	1/3	1/5	1/3	1	1
5	h_5	1/3	1/4	1/3	1	1

The components of the principal eigenvector are calculated as the geometric mean in the row of the matrix:

$$V_n = \frac{V_i}{\sum_{i=1}^{n} V_i}, \quad (3)$$

V_n = (0,365; 0,299; 0,178; 0,076; 0,08). The consistency of the factor weights is calculated by multiplying the priority vector (V_n) by the pairwise comparison matrix.

The approximate value of λ_{max} for assessing the consistency of expert judgments is calculated as the arithmetic mean of the vector components [17].

We get the vector V_{n2}= (5,72; 5,54; 5,22; 5,18; 5,14).

The next step is to determine the assessment of the consistency of expert judgments. λ_{max}:

$$\lambda_{max} = \sum_{j=1}^{n} M_j V_j. \quad (4)$$

From the calculations we get λ_{max} = 5,36, which is the main characteristic for establishing the degree of consistency of expert judgments, regarding pairwise comparisons of criteria in problems with linguistically uncertain quantities, for their solution the theory of fuzzy sets is used. The assessment of the obtained solution is determined by the consistency index:

$$IU = \frac{\lambda_{max} - n}{n - 1}. \quad (5)$$

Result IU=0,09.

Table 9
Consistency index value

Number of objects	3	4	5	6	7	8	9	10	11	12	13	14	15
Index reference value	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,54	1,56	1,57	1,59

Comparing the value of the consistency index and the tabular one for 6 objects, we obtain the inequality 0,09<0,1x1,24. This inequality indicates proper consistency of expert judgments.

5. Discussion of the research results

In general, the pairwise comparison method is a valuable tool for comparing objects according to a specific characteristic. It is effective, accurate, and reliable, but can be labor-intensive when comparing a large number of objects. From the results obtained, which are presented in Table 7, we can say that the highest rank, and therefore the most significant in creating the visualization, was the h_3 indicator - context dependence. The least significant, based on the results obtained and calculations performed, in our case was the h_5 indicator – composition, which was the least significant and received the lowest rank.

In web design, different types of images serve different functions, and each type of image is designed for a specific task or purpose. Logos and brand elements reflect brand identity. They help users easily recognize and associate a website with a particular brand or company. Illustrations and graphics are used to visualize information or concepts. They can help explain complex ideas, create infographics, and make content more appealing. Photos can be used to showcase products, services, employees, and to create atmosphere and mood. They add visual content and realism to a website.

Icons serve as a quick and concise representation of functions, actions, or categories. They facilitate navigation and identification of functions on a website. Background images are used to create atmosphere and reflect the style of a website. They can be an important part of web design and add depth. Banners and promotional images are used to draw attention to promotional offers, advertising campaigns, or important messages. They can be links to promotions or products. Slideshows and carousels are used to scroll through different images or messages on the home page or other pages of the website. They allow you to display a lot of information in a limited space.

Symbols and drawings can be used to create unique and interesting designs that stand out from the competition. Animation, such as GIF images or videos, can add dynamism and attract attention. It is used to show actions, processes, or demonstrate products. Art graphics are used to create artistic and creative web designs. They can be important for websites that aim to impress with an artistic approach.

The use of different types of images opens up a wealth of opportunities for web design and allows you to create more informative and engaging content for users.

Therefore, images have a significant impact on the perception of information in visual design. They not only complement the text, but also make the content more accessible and emotionally rich. The use of appropriately selected images has a significant impact on the emotional state of the audience. Emotionally charged graphic elements facilitate easier understanding and memorization of information. Of course, images can be a powerful tool for reinforcing key messages or ideas. Their use helps draw attention to important aspects and make content more memorable.

They can help: distinguish your messages from others and make them more appealing to view; be used to present data, ideas, or processes in a more understandable form; be used to create a positive or negative mood or to evoke certain emotions.

It is important to use images thoughtfully so that they are effective and do not distract from the main message. Here are some tips for using images: use images that are relevant to your message; use images that are high quality and well executed; use images that are clear and understandable; don't use too many images, as this can be distracting.

Using images in combination with text can be an effective way to convey information and leave a strong impression.

It is worth noting that images clearly help in the structural organization of content, making it more accessible and easier to read. They add visual hierarchy and organize information. Using images that match the brand style helps to strengthen the brand image and create a unified visual identity. In turn, the contextual use of graphic elements is an important component in ensuring their relevance to the topic and content. They should complement the content and carry additional meaning. It is also important to take user feedback into account and analyze analytics to continuously improve the use of images and their impact on content perception.

All these aspects demonstrate the importance of thoughtful and careful use of images in visual design to achieve maximum effectiveness and engage the target audience.

6. Conclusions

In our opinion, the value of this work lies in the comprehensive combination of visual analysis methods with mathematical tools for multi-criteria assessment, which made it possible to quantitatively determine the impact of different types of images on the effectiveness of visual design.

In most studies, evaluation is qualitative or descriptive. This study is the first to create a formalized hierarchical model of criteria that determine the effectiveness of image use (aesthetics, informativeness, relevance, emotionality, ease of perception, etc.) and to perform a quantitative calculation of priorities through pairwise comparisons by experts. This ensured the objectification of design decisions, which are traditionally considered subjective.

The study combined expert opinion and image characteristics (type, style, complexity, semantic load, degree of abstraction). This made it possible to obtain a generalized evaluation system that

works not only at the level of aesthetics, but also at the level of functional correspondence of images to design tasks.

Quantitative weight coefficients of the influence of different types of images on user perception have been substantiated. These results can be used as data for modeling UI/UX design, multimedia publications, and web interfaces.

Based on the hierarchy analysis method, an algorithm for selecting the optimal type of images according to specific criteria has been developed. In other words, the developed model can be used as a decision-making support tool for designers, multimedia publication developers, and UI/UX specialists.

Research shows that visual design can be the subject of quantitative analysis, not just creative interpretation. This opens up opportunities for integrating the hierarchy analysis method into automated design support systems.

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Declaration on Generative AI

The authors have not employed any Generative AI tools.

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