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COLOR AS A TOOL FOR CONVEYING INFORMATION IN INFOGRAPHICS

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Abstract

Color is a powerful tool that can be used to influence our emotions, behavior and perception of the world. Therefore, color has not only an aesthetic function, but it can also fulfill certain purposes. In addition to the symbolic transmission of information, it can help organize content or draw attention of recipients to specific elements. This is one of the key components that build an infographic. The importance of color in information graphics and some of the mechanisms of its effect are described in this article. Examples of infographics showing the importance of appropriate colors in practice are also analyzed. Colors can be used to highlight the most important information, grab the reader's attention, and make the data easier to understand. Properly selected colors can make the infographic more engaging.

Keywords: colors, infographic, information design, meaning of color

INTRODUCTION

In modern civilization, certain features of information society and the dominance of image can be noticed. Media broadcasters are increasingly looking for innovative solutions to draw the attention of recipients and contribute to the efficiency of conveying content. Meanwhile, one of the forms of communication combines most of the features that may be desirable – condensed information in the form of an image, which can be easily shared, for example on the Internet. This concerns visual messages presented as infographics, which Randy Krum (Krum, 2013, pp. 2-8; 27) defines as more complex entities than data visualization (e.g. charts), containing, texts, icons, illustrations. However, above all, he points out that an infographic should tell a story (Krum, 2013, pp. 2-8; 27). The name is a combination of the words: information and graphics, so the purpose of infographics is to graphically visualize data, information or knowledge in a quick and understandable way for the recipient, enabling them to see trends or patterns (Szklarek, Klamka, 2020).

A different point of view in the case of infographics as a journalistic genre is taken by Lech Mazurczyk (Mazurczyk, 2010, pp. 364-378). According to one of the best Polish

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infographic designers, information graphics is a full-fledged, separate journalistic genre. He states that infographics can take different forms, sizes or degrees of complexity. However, readability is still very important, so the information presented must be simple and clear. In addition, the effectiveness of the infographic is the most important – that is keeping the recipient's attention only for the time necessary to understand the message (Mazurczyk, 2010, p. 364-378). As Lech Mazurczyk points out, infographics can complement the text, and sometimes it is a separate entity and serves itself. There is one criterion in this case: if the infographic exhausts the topic, then the text becomes redundant. However, such cases, according to the author, are an exception (Mazurczyk, 2010, p. 364-378).

While discussing the elements of visual communication, it is essential to note that it is closely intertwined with visual culture, the roots of which extend to prehistoric times (Eddy, 2020). Visual communication is a powerful communication tool that is crucial in the interaction of individuals and groups. It involves conveying ideas and information through various visual elements. Visual messages can impact emotions and shape specific behaviors in recipients, motivating them to take action (Kujur and Singh, 2020). Another definition says that: visual communication is a discipline similar to graphic design, encompassing knowledge of ways to visually convey ideas using media such as typography, television, photography, film, illustrated writing, and comics (Wolny-Zmorzyński, Furman, 2013, p. 90-91).

For the purposes of this article, it is assumed that visual communication is the act of conveying information through images between different individuals or groups, and presenting information through images is crucial in imparting knowledge about reality. However, it should be noted that visuality is becoming commonplace, and to engage the audience, one should constantly explore newer methods and tools for delivering information through images.

COLOR IN INFOGRAPHIC – ITS MEANING, USE AND SELECTION

Infographics can help people understand complex data faster and easier. It can also be used to increase awareness of a given topic or encourage recipients to act or create specific attitudes. The readability of infographics is related to their correct structure, which consists of: appropriate layout, used elements, such as the amount and appearance of text, data visualizations, illustrations, the number of decorative elements, but also color palettes. Color can not only affect the mood of the entire project, but it can also segregate information, indicate what is important, be a guide for the recipient's eyes while reading, etc. These areas will be discussed in this paper.

Human brain acts more impulsively under the influence of emotions, color can trigger a specific sensation. Therefore, in graphic designs, it is a tool that serves specific purposes, and fulfills not only aesthetic functions. It can also be a substitute for the word, which is important in infographics. For example, it is enough to divide the image into two parts, one green, the other red and immediately the recipient knows that in one part there are things that are good or allowed to do, and on the other side those forbidden or harmful. It also refers to the knowledge of the meaning of color, a certain symbolism related to culture, which has been assimilated by a given recipient.

Well-balanced colors and friendly graphic design make the infographic noticeable and evaluated positively at a glance. The effect of the first impression can work here. The designer should arrange a color scheme in order to deal with possible problems resulting from poor color selection. It is also important not to choose colors randomly. They should correspond to the topic or content to which they relate. In addition, the selected colors used on the infographic should also harmonize with each other. Colors should be chosen in a way that is pleasing to the reader's eye and considers the preferences of the target group of the designed infographic.

Sneh Roy (Roy, 2009) in her article about elements of building information graphics and the principles of its construction, also points out the legitimacy of paying attention to color. Analyzing the anatomy of infographics, she distinguishes three categories: visual, related to content and knowledge. The first of them – visual – includes color coding of information, graphics and dedicated icons that correspond to the selected topic. The content layer is time frames, statistics, and sources of information. The third category, knowledge, refers to facts and conclusions arising from the presented information. In terms of the principles of building infographics, the author (Roy, 2009) lists five key principles of constructing a good infographic message. The first one is skeletons and flowcharts, i.e. mind maps that help organize content. The second stage is the preparation of the color scheme. The third stage is graphics. Roy points out that there are two types of graphics: thematic and reference. The first is the graphic theme of the entire project, and the second is described as icons that relate to a given theme, all kinds of visual indicators. The fourth stage, titled research and data, refers to the category of content described above in the anatomy of an infographic. The fifth and final stage is the knowledge that the infographic will convey to the recipient. In this case, it is worth paying attention to the second stage - the color scheme. As the author points out, coloring is very important to convey a wide horizon of information and at the same time maintain the reader's interest. If there are no colors that focus the recipient's thoughts, his attention will be distracted. Choosing the color scheme and assigning the meaning will allow better color management in the infographic (Roy, 2009).

A color wheel on which the primary and derived colors are shown can be useful in choosing the right set of colors. The process of finding the color sets according to the rules of color ordering as an easy process will be described below. It is also necessary to mark the basic distinction between warm and cold colors. Each color also has three properties that distinguish a color from others: hue, tone, and saturation. Hue refers to the name of a color – we are talking about red, blue, etc. Each of the colors has also many varieties – from light to dark - and these are the tones. Saturation, in turn, refers to the intensity of a given color (Dabner, Casey, Calvert, 2012, p. 92).

Color sets can be selected based on several rules: analogously, complementary, triadically, tetradically or based on monochrome. In the analogous scheme, three colors lying next to each other are used. The resulting palette is usually calm and harmonious. Complementary colors are those that lie opposite each other on the color wheel. Such a combination is very contrasting and not very pleasant to receive, but this does not exclude its use in infographics. The most important issue in this scheme will be the right tone and saturation of the selected colors. The triadic scheme uses three colors that are separated by an equal number of others on the wheel. The tetradic scheme, on the other hand, is a set of two pairs of complementary colors (Zimniak-Rucińska, 2019, pp. 129-130). Bo Bergström, relying on the NCS system, lists colors that whisper, speak and shout. The Natural Color System (NCS), developed by the Scandinavian Institute of Color, is built of colors naturally occurring in nature and the way they are perceived by the human eye. It is distinguished primarily by yellow, red, blue, green, white and black. The other colors are combinations of them. (Bergström, 2009, p. 203). Colors that whisper are those lying in the same square in the NCS scheme and harmoniously blend (e.g. orange and red). Colors that speak are contrasting, lie in different but adjacent squares of the scheme (e.g. blue and red). Finally, colors that scream - extremely contrasting and come from opposite squares of the scheme (e.g. green and red). However, it should be remembered and what the author also points out, such strong, screaming colors will attract the attention of the recipient, but they can also give the impression of cheesiness and lack of professionalism (Bergström, 2009, p. 203-204).

Color, especially in data visualization and infographics, is supposed to be useful, and it will be when it highlights key information or groups it. It is then easier for the recipient to refer to the viewed information (Biecek, n.d.). Bo Bergström also writes about

such color properties in *Visual Communication* (Bergström, 2009). He claims that color can organize and teach, for example, marking an important issue with intense color will make it more visible than other information. Bergström divides colors into functional and non-functional, pointing out that only the former is important in effective visual communication. Its impact should be aimed at attracting (colorful elements in vivid tones and a high degree of saturation will attract the attention of the recipient more), creating a mood (depending on the symbolism, the recipient may feel, for example, relaxed or anxious), informing and the already mentioned ordering and teaching (Bergström, 2009, p. 200-202). Referring to infographics, color can support the reception and understanding of a given topic, but also arouse misunderstanding or inappropriate reactions. The use of bright, warm colors will create a positive mood in the recipient. For example, discussing the subject of war using colors associated with the sun and fun could cause some dissonance.

COLOR PERCEPTION

The structure of the human eye is adapted to distinguish many colors. Thousands of years ago, man had to recognize the right color of plants to know which one was poisonous. He also had to spot and recognize a possible enemy. Hence, the eye and brain were able to quickly register and use information about color (Biecek, n.d.). Therefore, communing with color is a natural thing for human and accompanies him from an early age.

However, color perception can depend on many factors. The color may look different in the print and displayed differently on the monitor, in a dark room and in a light room. Also, the type and temperature of lighting will affect the perception of color (Biecek, n.d.). Also, the other colors, with which it appears on the design, can determine how it will be read by the recipient. There is a possibility of optical illusions, such as simultaneous contrast. The circle shown in the two backgrounds (Figure 1.) has the same color, tone and saturation, but depending on which one it is on, it seems to have a different intensity. Placing a color next to an intense color may cause the former to appear less saturated, while situating it next to a color with lower saturation may make it seem more intense (Peng, Tong, et al., 2022).

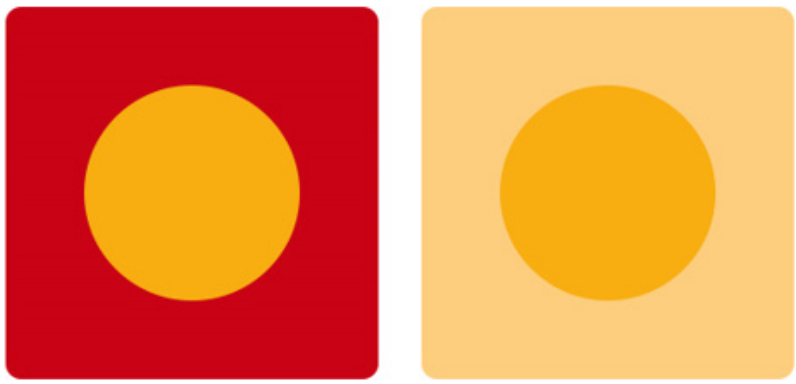

Figure 1. Example of simultaneous contrast; based on Dabner, Casey, Calvert, 2012, p. 94

Color affects the perception of the characteristics of objects in different ways. The size, distance and weight of an object may be perceived differently depending on the used color and its brightness. Light colors such as white, orange, or yellow optically enlarge objects, while dark colors such as black, brown, purple will reduce the surfaces on which they occur. In addition, warm, bright colors optically bring closer objects that also seem lighter, and cold and dark ones move away element and increase its weight. The color can also convey the impression of dryness (oranges, yellows) or humidity - blue-

ness, greens (Zabawa-Krzypkowska, Groń, 2017, p. 85).

As mentioned earlier, color is a way to make content stand out. Preattentive processing may apply here, which is an early stage of information processing and takes place before the conscious mind begins to work. This reaction takes place at the moment of processing external stimuli. The information is stored in the iconic memory before it goes to the short- or long-term memory. The former has been adapted to react quickly to changes in the environment. Therefore, with proper manipulation, e.g. the color of elements, the recipient (Pielużek, 2020) could more quickly notice it. To illustrate how these treatments (called preattentive attributes) work, the graphics shown in Figure 2. are often used.

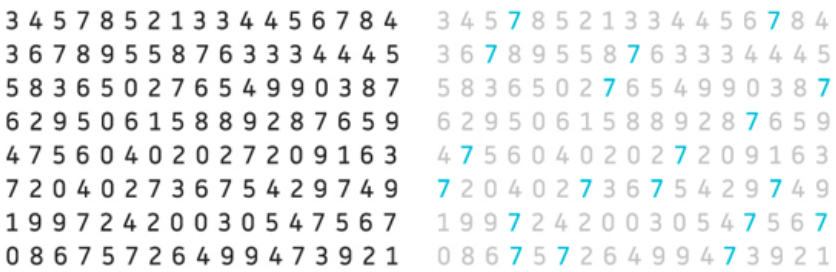

Figure 2. Use of preattentive processing; based on datascience.aero/brain-data-visualization/, online 31.03.2023.

In both examples, the information is the same, but in the second case the concentration falls on the numbers highlighted by color. Thus, the recipient needs less time to search for specific information than in the first graphic, where all digits look the same. Thanks to such operations, a fast, unconscious, and automatic process of perceiving differences is triggered. There is no need for the recipient to search for issues important sequentially and analytically to him, because knowing the process of preattentive processing, designer can use it to make it easier for the recipient to reach the desired information or suggest to him that these highlighted issues are important and worth noticing in the first place. This type of distinction can also be made with different intensity of colors that have been used.

It is also essential to consider the significance of colors and select them not only based on the principles mentioned above but also in terms of their potential meanings. Some reactions to colors are intuitive and universal, while others are acquired and dependent on the culture of a given society. For instance, red, one of the most potent colors, is often associated with love, warmth, as well as violence, warning, danger, and significance. On the other hand, shades of blue symbolize reliability, tranquility, wisdom, loyalty, but also sadness and coldness. Gray is frequently used in infographics and is associated with technology, industrialism, and intelligence. It serves as a neutral color and is often employed as a background (Güneş, Olguntürk, 2019).

To sum up, color, as well as the context in which it appears, has been an extremely important part of human life since the dawn of its history. It also has a huge impact on recipients, so, it can cause specific emotions or reactions, also draw the recipient's attention to a specific thing. Hence, it is a very important tool in graphic design, and in infographics it expresses much more than text.

THE USE OF COLOR IN INFOGRAPHICS – A CASE STUDY

In order to observe the essence of color in infographics and the operation of the mechanisms described above, it was decided to analyze sample infographics published on one of the Polish information portals (Figure 3.).

The analysis used the classification of infographics into its individual types between which the following types can be distinguished:

- data infographics (mainly statistical data, numbers play a major role),
- infographic of the place (the main element of the construction is a map),
- time infographic (a timeline or chronological order of events appears),
- a comparison infographic (compares two or more things)
- process infographic (each stage of a given process, development, etc.)
- visual infographic article (appearing with the article, referring to it, summarizing, may contain more text than the average infographic),
- characterizing infographic (describes the most important features of the presented thing/character, which is the dominant element of the image),
- quiz (characteristic construction on a question-answer basis).

The first example (a) shows an extensive infographic combining the infographic of the place and the characteristics of the topic - in this case it is about time changing. It can be considered that the infographic consists of five panels, starting with a title panel with a distinctive title and a few sentences of introduction to the topic. The next segments are maps showing in which countries daylight saving time applies and time zones exist. The last two parts are a small text panel and a final block describing the consequences of changing the time. It consists of icons and text. The information is given one by one with increasing detail – starting from global data to Europe, ending with data that may concern individual countries, institutions, and individuals. It is also information that can help the recipient draw conclusions about whether the time change is needed or make them aware that such time organization affects many elements. However, attention should be paid to the colors, which are neutral in relation to the discussed issue, they do not interfere with the reception. They are like a natural element of this construction. First of all, color has an ordinal and distinctive function here. At the top of the infographic, color segregation of information and indication of specific places on the map can be observed. In the last panel, apart from the blue color, red has been introduced, distinguishing elements that are associated with the negative effects of time changing. It is true that red is not used in this project anywhere else, but using this color for this data makes them additionally emphasized as negative.

The second example (Figure 3. b) shows an infographic representing a combination of types characterizing, data and infographic of the place. The topic is the fire at Notre Dame Cathedral. It has more diverse elements conveying information than could be observed in example 3a. Illustrations, icons, timeline, map, text blocks, and a bar chart can be distinguished here. As in the first example, the information is arranged in panels and is given to the recipient gradually. Despite the dominant neutral gray, the red color is strongly visible. Appearing on a gray background and next to gray elements, it indicates to the recipient what stands out from other data. For example, in the case of a bar chart showing funds donated to rebuild a cathedral, the red bar indicates the highest donor. In the first panel, red indicates the place of the building where the fire started, focusing the viewer's attention even more on this area. The location of the text on the red frame, in addition to a large exclamation mark, suggests that this information is extremely important, so such a visual procedure will certainly not be missed by the recipient. All red elements are visible almost automatically and immediately. The mechanism of preattentive processing works here. This mechanism is also noticeable in the third example (Figure 3, c), in which compulsory vaccination is marked with red dots. The infographic is not constructed from many different elements, mainly repeating shapes (circles), so without color distinguishing features, the analysis would be difficult. Color-coded data is more visible than if it were represented by numbers or shapes without color. Their color also segregates information and indicates those to which the recipient should pay spe-

cial attention.

The analyzed examples of infographics (Figure 3.) have neutral background colors, which is also an important element affecting the readability of the provided information. None of the icons, maps, data visualization or text competes for visibility with the background. As described earlier, it is important to keep in mind the issue of simultaneous contrast, especially when choosing a background color. Its color will not always be neutral, but it cannot compete with other objects and significantly affect the appearance of the shade of the colors used in them.

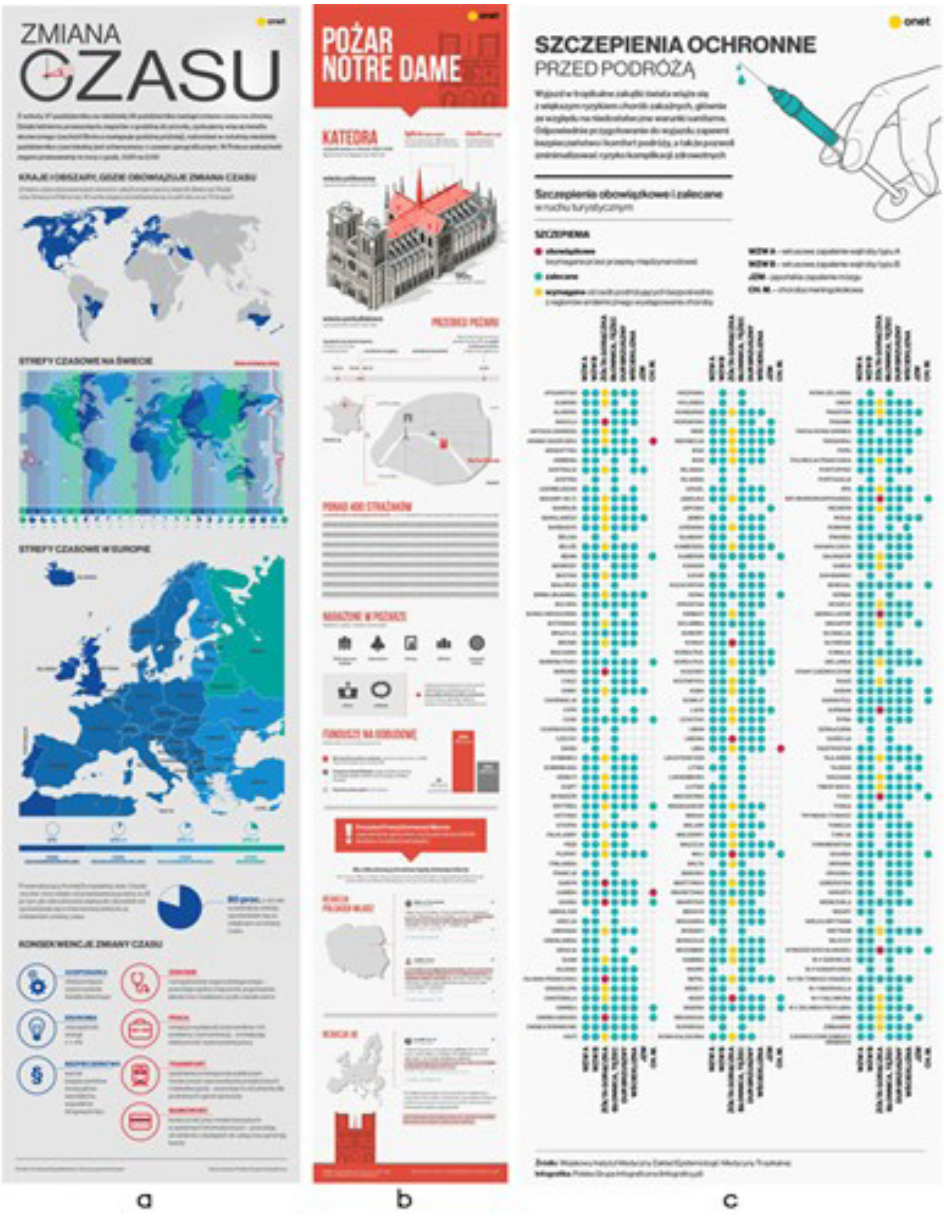

Figure 3. Use color in infographics; onet.pl, online 31.03.2023.

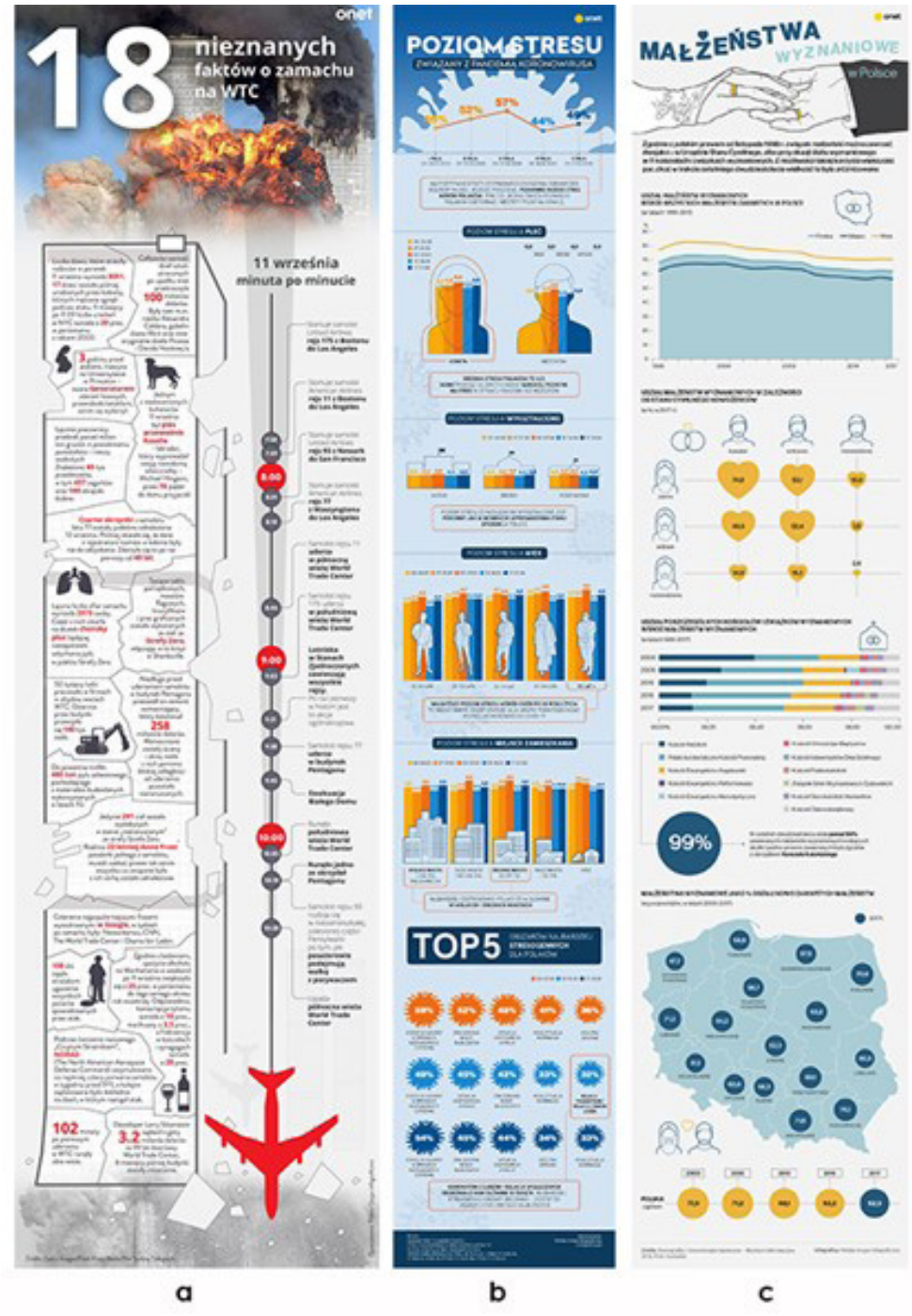

Figure 4. Use color in infographics; onet.pl, online 27.11.2023

The infographics from Figure 4. also illustrate the use of color as a tool for highlighting and organizing information. This distinction is particularly evident in the first example (Figure 4.a), where key elements are marked in red, signaling those that the recipient should notice amidst other information. This infographic combines two types: a visual article and a timeline. Highlighting crucial elements, using color, besides other methods, facilitates the recognition of essential information especially in visual articles, where content is typically more abundant than in an average infographic. In this example, apart from a strong red hue, no other intense colors are used, and dominant neutral gray color prevails. This choice makes the elements indicated by the infographic's author even more conspicuous. The second example (Figure 4.b) is a data infographic that is more extensive in terms of color than the previously analyzed example. Shades of orange and blue are employed mainly. The darkest shade of orange serves as the highlight for the

largest data points in the dataset. By using different hues and adjusting the size or length of elements, the recipient can discern which elements indicate the highest figures. The logical arrangement of elements is connected to their color. Additionally, color serves here as an organizing function for the information presented in the infographic – each color is associated with a specific data category. A similar organizational function is performed by color in the data infographic in the third example (Figure 4.c). In the multivariate bar chart in particular, the differentiation of colors is crucial to enable the recipient to easily associate numerical data with categories and compare results. However, there is a lack of using color as a distinct marker. For instance, in the chart in the second panel, the data point with the highest numerical value could be additionally highlighted with at least a different shade of color. Similarly, on the map in the penultimate panel of the infographic, this would facilitate a quicker identification of which data point indicates the highest value.

It should also be noted that color, beyond its distinguishing and organizing functions, serves a distinctly aesthetic purpose. Therefore, a thoughtful combination of colors is crucial to generate interest aesthetically for the recipient. The examples of color use for aesthetic purposes can be observed in the infographics from Figure 5. The first infographic (Figure 5.a) combines various types of infographics, including location, timeline, and characteristics. The color scheme is consistent throughout the project, but in this case, the color primarily organizes information instead of highlighting the most crucial elements. Although red is highly noticeable, it does not appear to function as a distinct marker. Due to the cohesive color palette, the infographic is visually pleasing, indicating that, in this case, colors also serve an aesthetic function. The second example (Figure 5.b) relies mainly on shades of blue with small accents of warm colors – shades of red, orange, and yellow. Here, in addition to aesthetic purposes, color also serves an organizing function for the presented information, with the appropriate color shade matched depending on numerical data. The colors from the third example (Figure 5c) also form a very consistent combination – using two cool colors, blue and green. They are well-suited to the discussed theme of gaseous pollution as a remedy for smog. Although, when discussing smog-related data, colors less associated with nature and ecology could be considered. Therefore, color serves an aesthetic function here, ensuring that the infographic looks coherent and harmonious. Additionally, color organizes information, but it is not evident that any of the colors function as a distinctive marker for information that the recipient should notice first. All data appear to be on the same hierarchy level, allowing for intuitive data interpretation from top to bottom.

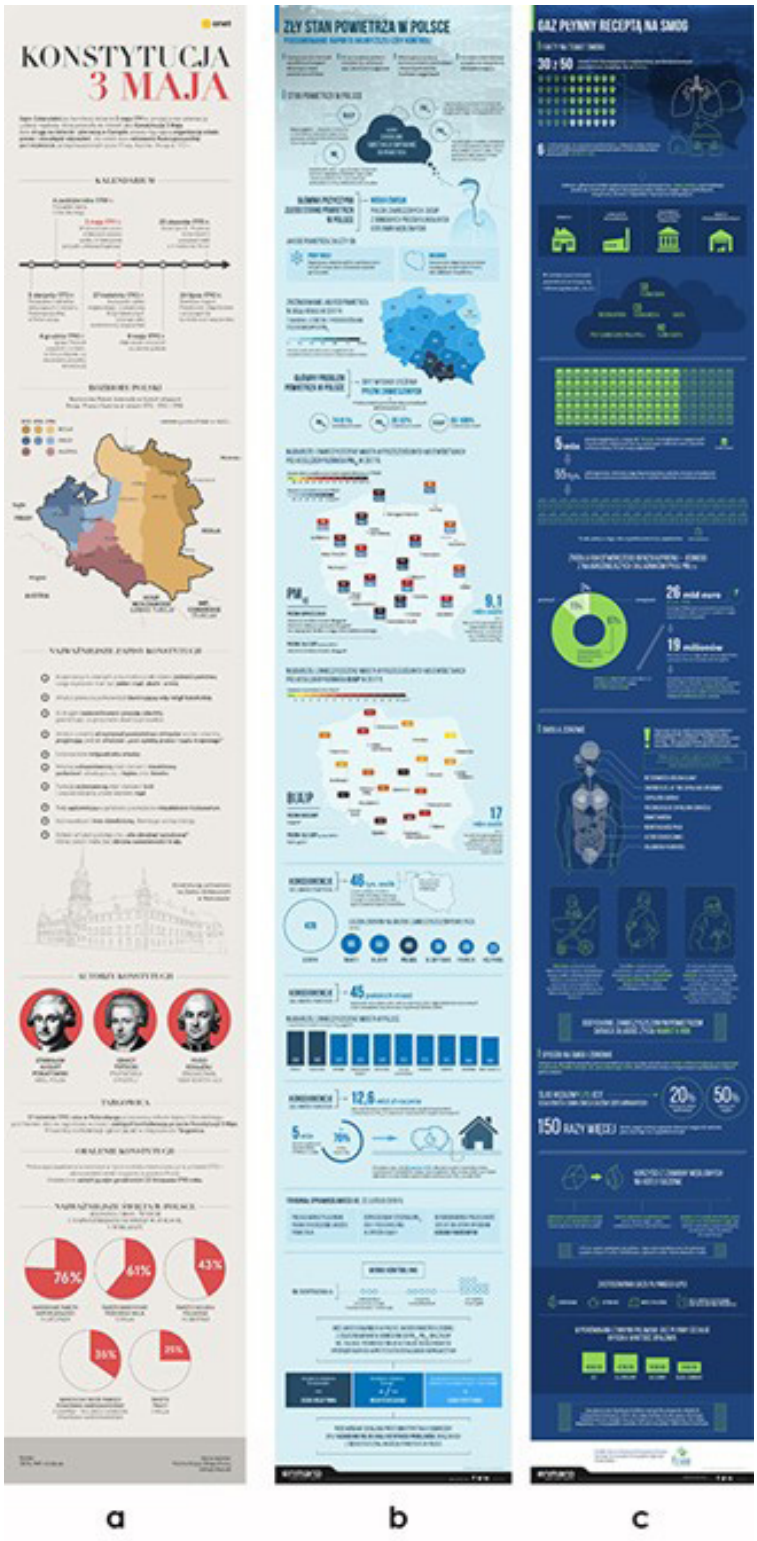

Figure 5. Use color in infographics; onet.pl, online 27.11.2023

An informative function of color emerges from all the described examples. Color can encode information about data categories, values, and convey hierarchical content information. It can be utilized to indicate trends or changes in data over time. A change in color or intensity can subtly indicate the development of a situation or the evolution of data. Additionally, it can highlight differences or similarities, thereby communicating relevant information to the recipient.

This phenomenon is even more noticeable in an entertainment infographic: quiz –

What type of music fan are you? (Figure 6.) – due to the used color scheme. Turquoise background and intense pink create a contrasting combination. It consists of text frames, lines leading the reader to the appropriate parts of the image and illustrations. This type of construction is readable and intuitive, the colors draw attention, but due to such a strong contrast it can also be tiring for the recipient's eye.

Therefore, a small change in the intensity of colors and their different adjustment to the elements making this information graphic more accessible should also be considered.

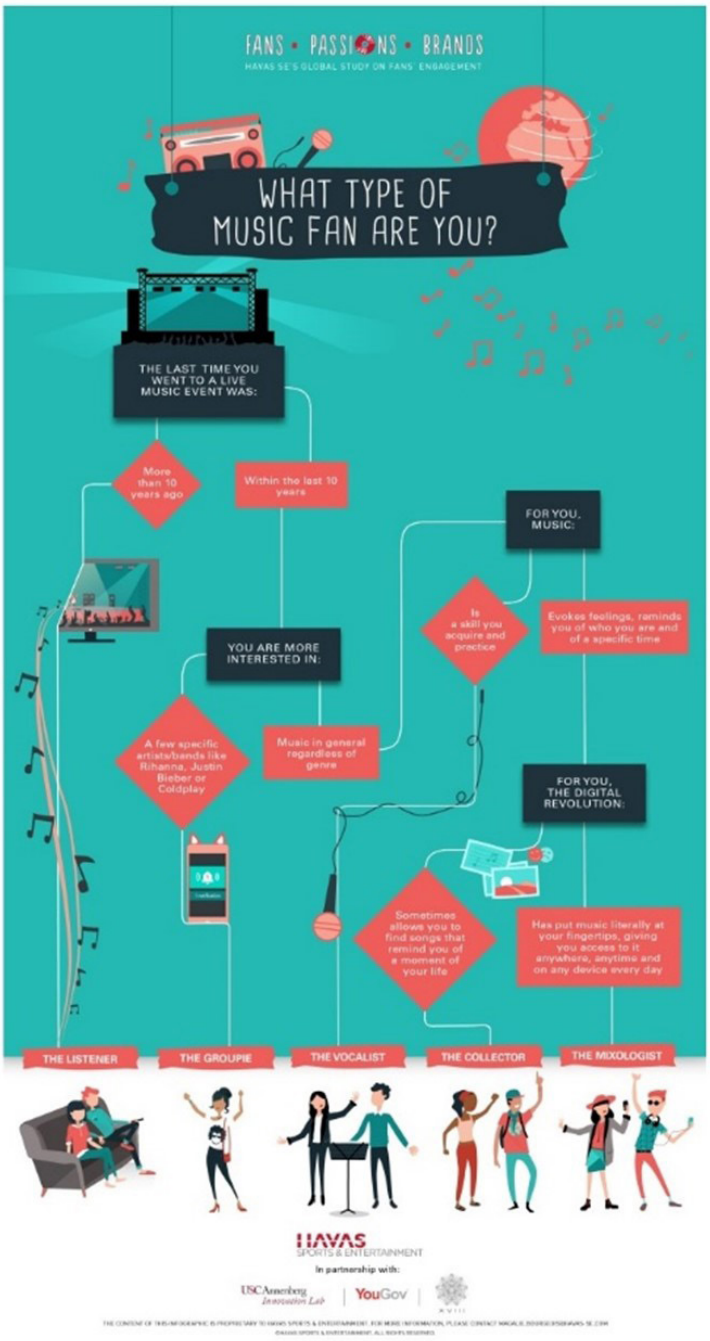

Figure 6. Entertainment infographic, quiz; reasonwhy.es, online 31.03.2023

The color scheme, as well as the arrangement from Figure 7. reflects the quiz infographic from Figure 6. published on the web. Originally, the background is a saturated shade of turquoise, and, on it, there is an equally saturated pink and several dark, na-

vy-blue elements. The bottom panel is fully white with colorful illustrations of the figures. However, to turquoise and pink colors show the effect of simultaneous contrast in practice. Both colors strongly interact with each other, creating a contrast that is not pleasant to the eye. Pink seems more saturated and flashier than it really is. Separately, both colors look attractive. Together, in such proportions on one project, they pay more attention than information. In the second example, two of the same colors of navy blue and pink were used, and turquoise had reduced saturation and had been brightened. The colors were used in different proportions - pink was applied to the blocks that were originally the title, final answers and questions, that is, those elements that should be noticeable and set the direction of reading for the recipient. On a dark background, they seem to be crucial. It is also important that pink no longer competes with any other color. Thanks to this, information, not contrasting colors, plays the leading role. This procedure shows that working with colors in infographics is important and can significantly affect the recipient's perception of content.

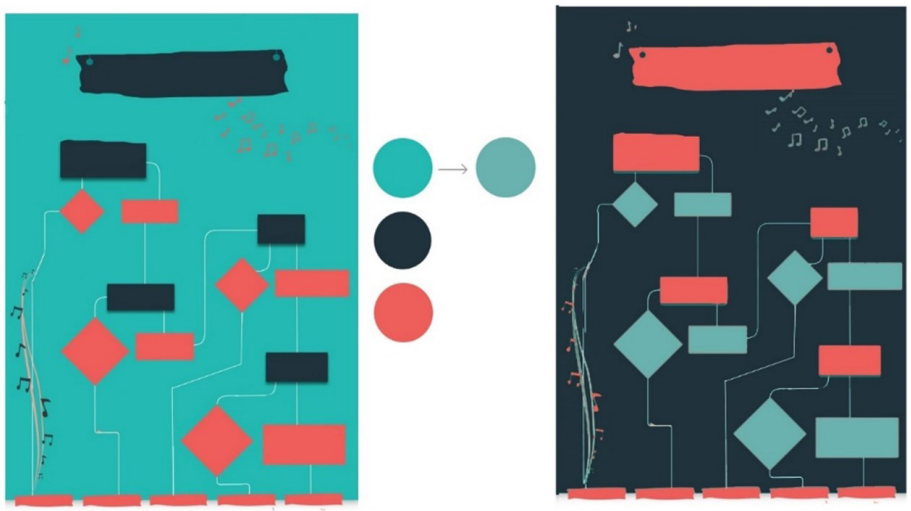

Figure 7. Example color scheme in infographic; based on infographic from reasonwhy.es, online 31.03.2023

CONCLUSIONS

The aim of the article was to identify the functions and roles that color can fulfill in infographics. As it turns out, color in graphic design can serve various roles and fulfill different functions. Four fundamental functions can be highlighted:

- organizational: helps organize information, creating a visual hierarchy and aiding in the structured presentation of data.
- differentiating: highlighting specific elements or data points. This function draws attention to crucial information, making it stand out from the rest and facilitating the viewer's focus on key details.
- aesthetic: thoughtful color combinations improve the aesthetics of the design, making it more engaging and visually attractive to the audience.
- informative: color informs about hierarchy, similarities, differences, trends, significance, encoding categories, and numerical values.

In the case of infographics, the right color scheme is important because it can highlight the most essential information. This can help users understand the information and focus on what is most relevant to them quickly. Moreover, color can also organize

the knowledge given in the information graphics. With the appropriate arrangement of elements, but also colors, individual sections and group of information could be designated. It will also help the recipient to trace visual messages easily. The color can be used to determine the way of reading, which will also positively affect the intuitiveness of the project. In addition, the color, simply, has an aesthetic function. It can create a visually attractive design, attract the attention of the recipient, and encourage to watch the presented content. However, the color palette used in the infographic can also be an obstacle to its reception. Therefore, planning the color scheme in advance and matching colors to the appropriate elements is essential. Then, they may not be irritating to the eye of the recipient.

Connections that may cause optical illusions or interact with each other in such a way that they do not look attractive or suggest different data than intended should be avoided. Colors can also correspond to the purpose of the infographic, creating a specific mood. Information graphics can be an effective tool for conveying information and engaging users while applying the right and clear design of infographics, including the correct selection of colors or information graphics.

Color plays a significant role in infographic design, influencing both functionality and aesthetics. Designers should strive for a balance between visual appeal and the comprehension of conveyed content, with an awareness of the mechanisms of image processing by the audience constituting a crucial element in this process.

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