White Paper

THE POWER OF MAPS

Geographical maps in the context
of cognitive psychology

Contents

Graphics

1. Introduction

"*A picture is worth a thousand words.*" This famous phrase has its origin in December 1921, when Frederick Barnard, an advertising expert for the *Street Railways Advertising Company of Chicago*, published a new way of advertising on streetcars in the trade magazine, *Printers' Ink*, by promoting the use of advertising with pictures and illustrations.[1]

Even then, Barnard assumed that pictures – unlike words and texts – are immediately understood and absorbed by our brains. In the December 1921 issue, Barnard was advertising with the headline "*One Look is Worth a Thousand Words.*"[2] It wasn't until a few years later, when Barnard placed another ad in the trade magazine on the same topic, that he changed his original headline to the world-famous phrase, "*One Picture is Worth a Thousand Words.*" But what is actually behind the fact that pictures immediately sear into our brains? Why do we remember them so well? And why do geographic maps have an even greater advantage over "normal" pictures? This whitepaper aims to answer these questions.

First, a brief presentation on the neurological basis of image perception will be given. This will serve to provide a better understanding of the perception and the reception of illustrations and images – which also includes maps. Afterwards, insight into the cognitive-psychological basics of image perception, in connection to different memory systems, will be provided. Section 5 will highlight the most prominent studies on the acquisition, perception, and memorizing of geographic maps in the context of the aforementioned foundations.

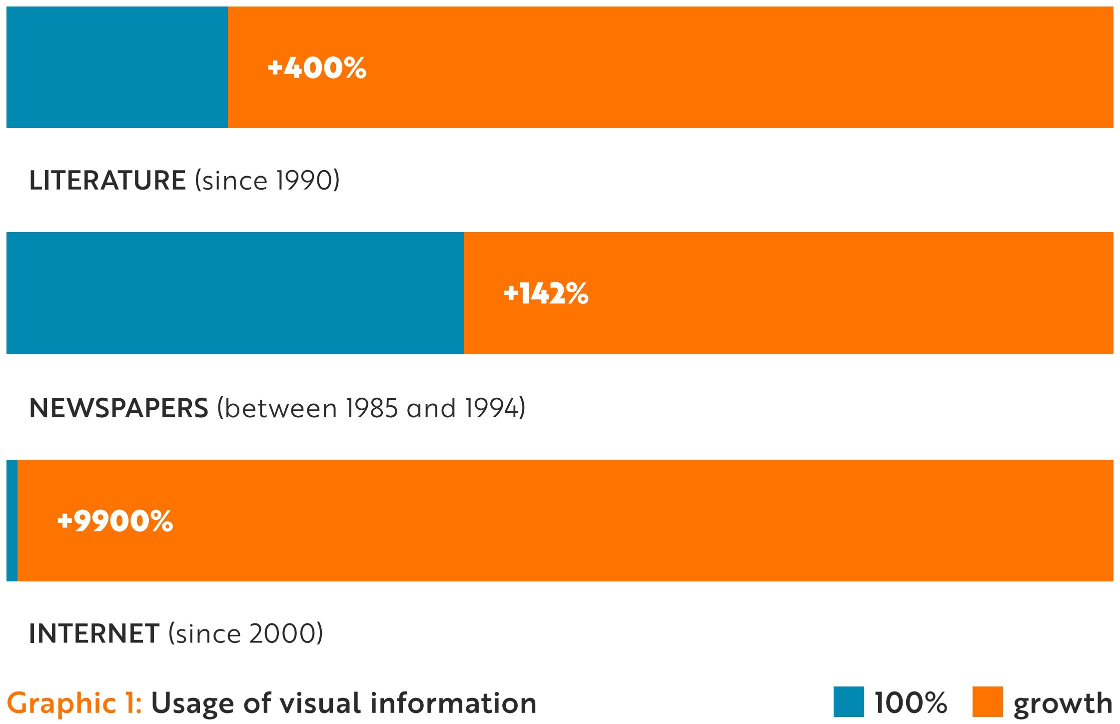
[1] When I refer to images or illustrations in the following, both types of visual information are always meant. The two terms are used synonymously.

[2] cf. https://www.phrases.org.uk/meanings/a-picture-is-worth-a-thousand-words.html (Retrieved on: 01-19-2021). https://www.br.de/radio/bayern2/sendungen/kalenderblatt/0812-ein-blick-sagt-mehr-als-1000-worte-102.html#:~:text=%22Ein%20Bild%20sagt%20mehr%20als%20tausend%20Worte%22%20hei%C3%9Ft%20es%20im,Jahre%2C%20wird%20als%20ihr%20gro%C3%9Fer (Retrieved on: 01-19-2021).

2. Effects of images and geographical maps

Illustrations and pictures create many different effects. They arouse the reader's interest, which text alone can only accomplish in very few cases. When we look at newspapers, magazines, and online articles, it is clear that they do not exist without images. They create the necessary attention to get the reader to read the text. Additionally, images provide for the reader's pleasure. Moreover, images can influence the reader's attitudes and even create emotion.

Difficult content can often be conveyed more easily through pictures and illustrations than through words.[3] It is therefore not surprising, that in our digital age, pictures and illustrations are becoming more and more widespread. Maps, too, "are images with specific graphic and conceptual properties, where reception is largely determined by the functionality of the visual system."[4] Thus, they also belong to these media and now exist not only in pure paper form, but are also largely generated digitally and shared online, whether in mailings, social media, web map servers or APIs. This is also referred to as the age of *web mapping*.[5]



Graphic 1: Usage of visual information

[3] cf. Levie, Howard W./ Lentz, Richard: Effects of Text Illustrations: A review of Research, in: Educational Technology Research and Development 30 (1982), p.195.

[4] Zyszkowska, Wieslawa: Visual features of cartographic representation in map perception, in: Polish Cartographical Review 48 (2016), p.5.

[5] cf. Kent, James Alexander: Form Follows Feedback: Rethinking Cartographic Communication, in: Westminster Papers in Communication and Culture 13 (2018), p.97f.

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The *NeoMam Studios* took a closer look at the usage numbers of visual information, including current research. They report that the use of visualized information has grown tremendously in recent years and decades. To determine this, the company used Google analytics to establish percentages about the use of visualized information on the Internet. In literature alone, the use of visualized information increased by 400% since the 1990s, in newspapers by 142% between 1985 and 1994, and on the Internet by as much as 9900% since 2000.[6]

This shows how important visual information is. Most importantly, it also shows how quickly and easily visual information is understood by everyone, making it increasingly common.

If we look at the usage history of maps in this context, it becomes clear that they are a constant part of our lives.[7] Today, it is hard to imagine life without maps, whether in the classroom, on integrated navigation systems in cars, in advertising, or in everyday life on cell phones. But how are images and maps actually processed neurologically in our memory and how quickly does this happen?

[6] https://books.google.com/ngrams/graph?content=infographic%2Cdata+visualization%2Cinformation+graphics&year_start=1940&year_end=2013&corpus=15&smoothing=3&direct_url=t1%3B%2Cinfographic%3B%2Cc0%3B.t1%3B%2Cdata%20visualization%3B%2Cc0%3B.t1%3B%2Cinformation%20graphics%3B%2Cc0 (Retrieved on: 01-18-2021).

[7] cf. https://trends.google.com/trends/explore?date=2004-01-01%202021-01-18&q=maps (Retrieved on: 01-18-2021).

3. Neurological basics of image perception – images vs. words

"The importance of vision for human cognitive performance can hardly be overestimated."[8] As the author of this sentence aptly summarizes, there is hardly anything more important for humans than vision. We use it to recognize our surroundings, movements, objects, people, and much more. Thus, vision serves primarily to absorb information, but also initiates the appropriate behavior in response to the information received. However, vision is also responsible for communication, as we can, for example, visualize thoughts with it.[9] 70% of our body's sensory receptors are located in the eyes. The optic pathways that carry encoded information from the eyes to the brain contain over one million nerve fibers. Only the nerve pathways that are responsible for our muscles contain more![10] Therefore, our visual system is able to recognize and categorize images and illustrations of natural visual scenes with remarkable speed.

For example, images of moderate complexity presented for only one to two seconds are remembered over the long term. In contrast, only five to seven simple words can be recorded in the same time frame, and these are also poorly remembered. Tachistoscope tests[11] have shown that we are able to recognize images and their content thematically after only one hundredth of a second, as well as describe and successfully remember them. Thus, images can be absorbed in larger sensory units than linguistic information.[12]

"It has been known since the 1960s that our ability to recognize images once we have seen them is immense."[13] Neurological studies on this have shown that the recognition of objects, scenes, and images happens immediately, before we even notice it ourselves. However, measuring this recognition experimentally often proves difficult.

[8] Translated from: Mallot, Hanspeter A.: Visuelle Wahrnehmung. Visual Perception, in: Funke, Joachim/ Frensch, Peter A. (ed.): Handbuch der Allgemeinen Psychologie – Kognition, Göttingen 2006, p.127.

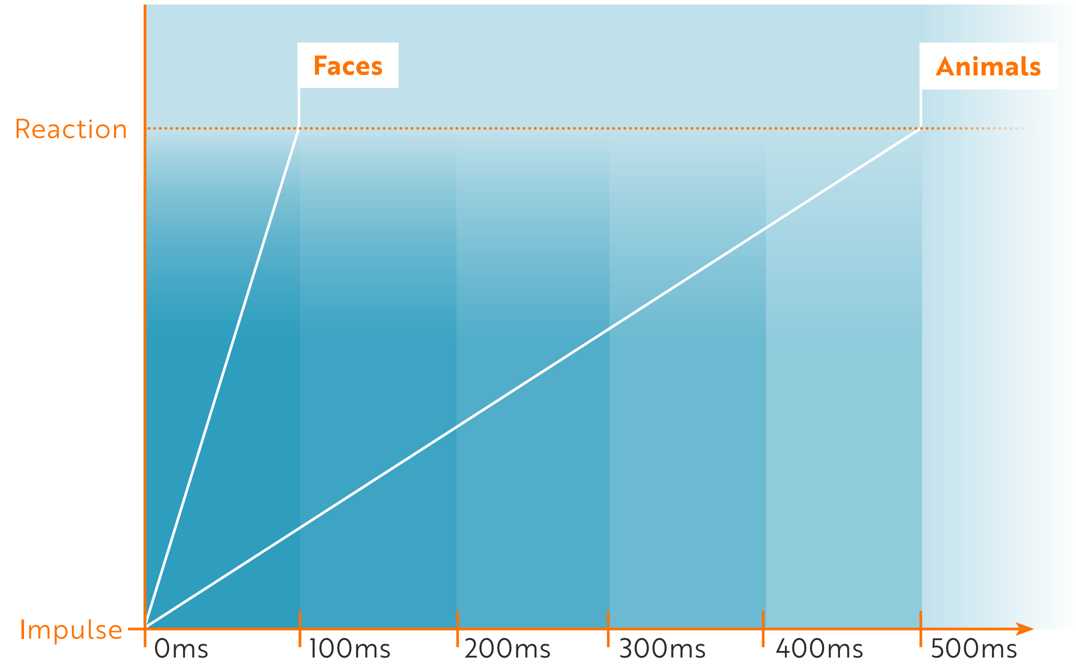
[9] cf. Mallot, Wahrnehmung, p.127f.

[10] cf. Marieb, Elaine N.: Human Anatomy and Physiology, California 1989, p.492.

[11] A tachistoscope is a device that is used in perception research. It is used to present visual stimuli within a very short period of time. This presentation usually happens within seconds. Nowadays, computers are primarily used for this task.

[12] cf. Faas, Thorsten/ Arzheimer, Kai (ed.): Information – Wahrnehmung – Emotion. Politische Psychologie in der Wahl- und Einstellungsforschung, Wiesbaden 2010, p.72f.

[13] Translated from: Engelkamp, Johannes: Gedächtnis für Bilder, in: Sachs-Hombach, Klaus/Rehkämpfer, Klaus (ed.): Bild – Bildwahrnehmung – Bildverarbeitung, Wiesbaden 2004², p.227f.



Graphic 2: Image perception

Nevertheless, experiments and studies have been able to establish that faces, for example, can be recognized within just 100ms. In widely used scientific tests, Simon Thorpe and other scientists showed their subjects 4000 unfamiliar color photographs. Half of the pictures contained animals, the other pictures contained objects, flowers and various landscapes. In this study, there was an average of 94% correct response rate in the recognition of animals. The reaction time for visual processing averaged 382-445ms. It is important to note that there is a shorter reaction time for faces because their unique features (eyes, nose, mouth, etc.) allow them to be recognized more quickly than the unfamiliar scenes presented to the subjects. This is due to the fact that we can assign and process familiar things faster than unfamiliar things. Nevertheless, it is assumed in research that when we perceive images, a reaction generally develops after about 150ms, which means that we perceive and process images much earlier than we even actively react to them.[14]

[14] cf. Thorpe, Simon/ Fize, Dennis/ Marlot, Catherine: Speed of processing in the human visual system, in: Nature 6 (1996), p.520f.

4. Psychological basics of image perception – memory systems

Memory is the term used to describe the cognitive system. It encodes information, stores and transforms it, and recalls it. During encoding, when a stimulus is presented to the body – in this case to the eye – it is transformed into a neuronal code, which can then in turn be processed by our brain. Storage, on the other hand, is responsible for the brain retaining or storing these processed memories. Recall is the ability to bring past experiences back into our consciousness.[15]

Graphic 3: Memory systems

Theories of memory explain the retentive capacity of memory. These can then be used to make predictions about various retention abilities.[16] Often, the first distinction is between short-term and long-term memory, which was already introduced by William James in the 19th century. In this model, memory is viewed as a multiple memory. The short-term memory serves the storage of currently available memory contents, whereas the long-term memory stores available contents, which are not permanently activated.

The psychologist Endel Tulving has also suggested that a distinction should be made between semantic and episodic memory, both of which are anchored in explicit memory. Semantic memory refers to general knowledge, such as knowing the months of the year, that the sky is blue, or that water is wet. Episodic memory[17], on the other hand, refers to situation-specific knowledge about certain events, e.g., about buying a newspaper on a certain day and place. In the case of pictures, episodic knowledge would thus refer to the presentation of a certain picture at a certain place at a certain time.[18]

[15] cf. Vaterrodt-Plünnecke, Bianca/ Bredenkamp, Jürgen: Gedächtnis: Definition, Konzeptionen, Methoden. Memory: Definitions and Methodological Approaches, in: Funke, Joachim/ Frensch, Peter A. (ed.): Handbuch der Allgemeinen Psychologie – Kognition, Göttingen 2006, p.297.

[16] cf. Engelkamp, Johannes/ Rummer, Ralf: Gedächtnissysteme. Memory Systems, in: Funke, Joachim/ Frensch, Peter A. (ed.): Handbuch der Allgemeinen Psychologie – Kognition, Göttingen 2006, p.307.

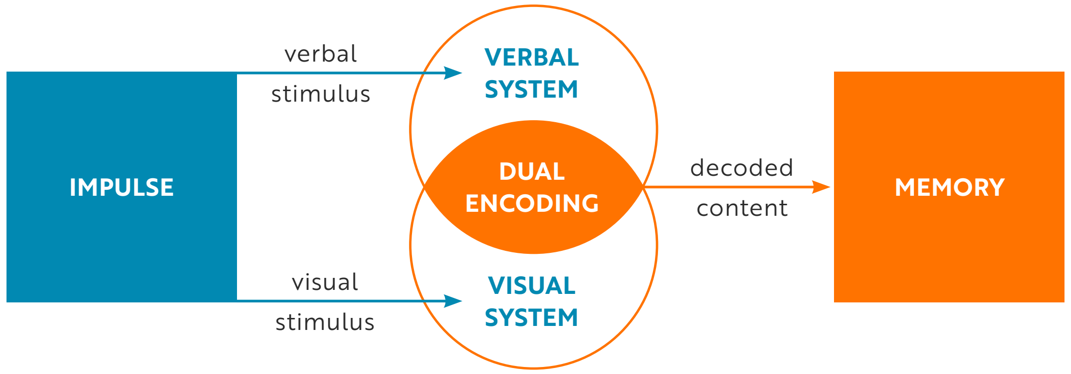
[17] Tulving also co-founded procedural memory as a further category. However, this will not be explained further at this point, as it is not relevant for the present White Paper.

[18] cf. Engelkamp, Gedächtnis, p.227f.

4.1 Image perception: dual encoding and picture superiority effect

"So-called system or code models of memory do not address the separation of a short-term and a long-term memory, but try to explain the variability of memory performance by assuming systems that are specialized for certain information – e.g., linguistic and non-linguistic, respectively."[19]

The first theory developed for this purpose was by Allan Paivio, who developed the code model in 1970. It assumes two different stimuli – namely the linguistic and the non-linguistic (and thus visual) stimulus. These are first processed and then stored in a memory system specialized for the stimulus. In this context, he proposed the theory of *dual encoding*, based on the assumption that not only are objects better remembered than labels, but also concrete words are remembered better than abstract ones. Here Paivio assumes a verbal and non-verbal memory. The verbal system is based on our experience with linguistic episodes and stores verbal-semantic knowledge. In contrast, the visual-nonverbal system is the result of our visual experience of nonverbal episodes and stores nonverbal-semantic, visual knowledge.[20]



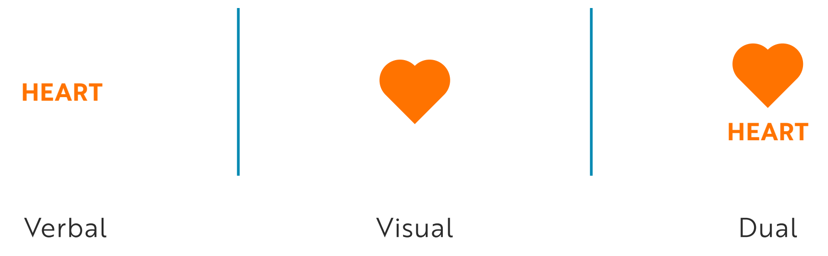
Graphic 4: Theory of dual encoding

Within the course of these theories, it was also assumed that when one stimulus is encoded, the other is automatically activated as well. This means that when we perceive pictures, there is an automatic encoding of visual-nonverbal knowledge, but in the process the corresponding verbal knowledge (i.e., the picture label) is often encoded as well.[21] For example, when we read the word "tree", we often automatically imagine the image of a tree in our inner eye. Since this dual encoding happens significantly more often with pictures than with words, pictures can be better remembered and also recalled. This is also called the *picture superiority effect.*

[19] Translated from: Engelkamp/Rummer, Gedächtnissysteme, p.310.

[20] cf. Engelkamp/Rummer, Gedächtnissysteme, p.310ff.

[21] cf. Engelkamp, Gedächtnis, p.228f.



Graphic 5: "Picture superiority effect" example – heart

The *picture superiority effect* describes the superiority of pictures over texts. This is because pictures are more accessible and can be understood by everyone. Even in the case of linguistic and cultural differences, a picture can therefore be understood better than words. They are also decoded more quickly than texts and can therefore also transport information more quickly into our memory. In turn, this rapid decoding by our memory means that they can also be retained for longer. Images are taken quasi-automatically *"and processed with little cognitive control."*[22] This has also been shown in neuroscientific studies, which have proven that an image is processed faster than any reaction occurs.[23]

Paivio's model was further developed in the 1970s by Douglas Nelson. Nelson proposed an additional pre-semantic system based on Paivio's theories. The model is called *sensory-semantic theory* and distinguishes three different subsystems: a verbal and nonverbal system, both of which are pre-semantic, and a conceptual system, into which both pre-semantic systems have access. He also assumes a dual encoding in the sense of Paivio, but according to him this does not run automatically, but strategically. This means that when a word is presented, the visual representation is only activated if a person also actively tries to imagine this word. In contrast to Paivio's idea, the system developed by him is supplemented in Nelson only by the conceptual one.

However, this also changes the cause of the *picture superiority effect*: it may result from the greater memory effectiveness of the visual as opposed to the verbal system, or it may be based on better encoding of pictures as opposed to words. In addition, Nelson's studies have encouraged further studies by other researchers who assume that the retention of similar sounds is impaired when the subject is presented with only a linguistic stimulus. This does not happen when the stimuli are presented pictorially.[24]

[22] Translated from: Faas, Wahrnehmung, p.72.

[23] cf. Levie, Illustrations, p.195ff.

[24] cf. Engelkamp, Gedächtnis, p.228ff also Engelkamp/Rummer, Gedächtnissysteme, p.310ff.

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5. How we understand geographical maps from an early age

This century's research describes maps as *"'channels' that transmitted information from a source (the world) to a recipient (map reader)."*[25] Moreover, they trigger emotions in the map reader or recipient and create connections to places, other people, etc., which in turn builds trust in a map.Study results, mainly from educational science and cognitive psychology, have shown that this is particularly due to the fact that we come into contact with maps from an early age – typically through children's books, magazines or television that contain geographical maps.

At the age of four, children can already memorize the first coordinates of a map as well as its object arrangements. These "basic skills" for reading and understanding a map therefore develop even before the start of formal schooling. However, these skills do not mean that children can actually use maps for navigation. *"Instead, their exposure to maps establishes a prior knowledge base that sets maps apart from other spatial displays that are less familiar, such as graphs and flowcharts."*[26]

Later in the classroom, maps are also one of the most commonly used illustrations, as they are used both in print and in lectures to facilitate learning.[27] It is here, according to study findings by Endel Tulving, that semantic memory is activated when maps are used, and in the process map information and elements are easily and quickly encoded through prior experience and knowledge. Prior experience, acquired as early as infancy, as described above, also explains why there is little difference between novices and experts in the context of learning and retaining map information. The foundation for this is laid in infancy and, according to research by Kulvahy, is generally widespread and well established in our population. Recognizing, learning, and understanding maps is therefore a familiar act.[28]

These studies have also found that maps can positively influence memory for texts read concurrently. Students who had maps available during the reception of texts were able to recall more text content than students who did not have maps available. Students who knew only fragments of the map also performed better than those without. Learning a geographic map always means using semantic memory, because prior knowledge and experience with maps play an important role. However, this learning is extremely easy due to the above-mentioned familiar knowledge of maps from a very young age.

[25] Kent, Communication, p.97.

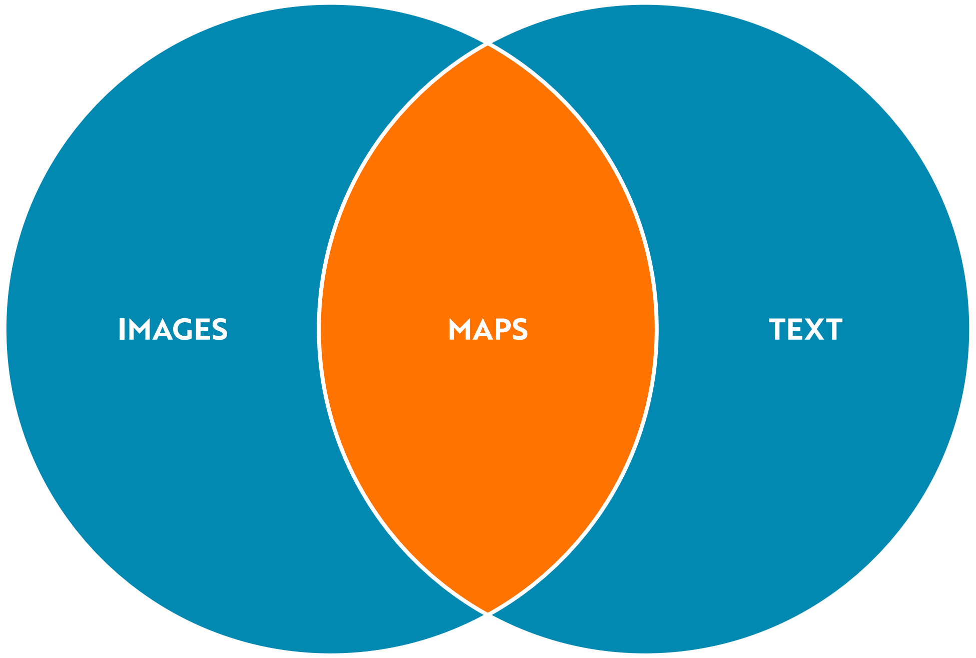
[26] Kulhavy, Raymond W./ Stock, Wiliam A./ Kealy, Wiliam A.: How Geographic Maps Increase Recall of Instructional Text, in: Educational Technology Research and Development 41 (1993), p.48.

[27] cf. Kulvahy, Maps, p.47ff.

[28] cf. Kulvahy, Maps, p.49.

5.1 Perception of geographical maps

So how are maps perceived and encoded in the context of the cognitive psychology theories presented? First, it must be stated that this depends in particular on the factor of experience in dealing with maps, as already explained in the previous section.



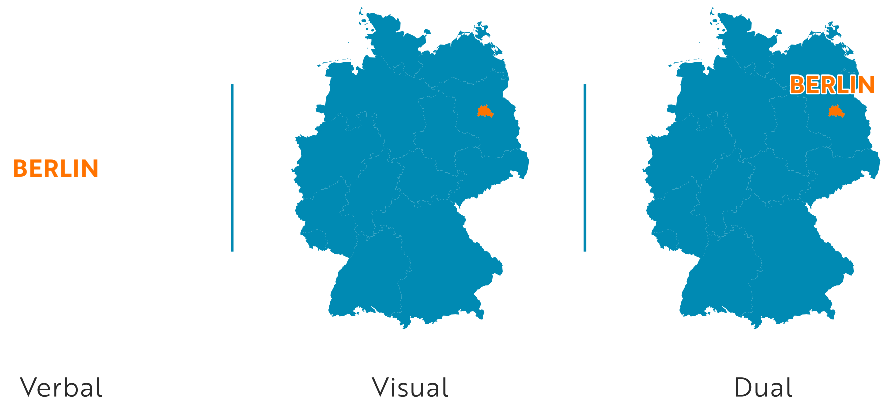
Graphic 6: **Maps – combining image and text**

The graphic format of a map provides a visual summary that communicates both information and complex spatial patterns within an instant. When reading, the viewer stores a mental pictorial representation of the map in his or her long-term memory. A map always contains various feature information relating to the visual properties of individual objects located within the map space. These are, for example, landmarks, paths or labels.

In addition, a map also has structural feature information that is also encoded in the image of the map and thus can be easily recorded by the reader. This structural information includes the spatial features of the map, such as direction, distance, boundary relationships, etc. Kulvahy's studies point out that these distinctions between features and structures are important for understanding why and how maps function within the human information system. The processing of global structures in scenes and images, but especially in maps, has been discussed as automatic by vision researchers in recent years.

Neuropsychological analyses of images in general also support the construct of a partitioning of features and structures as they are activated together during memory retrieval. This circumstance does not happen for abstract images or words, since features and structure are poorly recorded and thus poorly remembered. Therefore, the more precise an object or picture is, or the more structured and real a map is, the better it will be retained in memory. Images and illustrations are thus perceived and processed quickly, but recall is optimized when the image features are encoded in a structural framework. Maps provide this structural framework and thus enable the recall of features as well as textual structures. This means that when they are encoded, they activate both of the memories mentioned at the beginning. This happens because maps have textual information in addition to the actual topographic map material.

Research also assumes in this context that verbal and nonverbal memory activate each other and that what is stored can be retrieved mutually. This means that the encoding of maps takes place in nonverbal memory, which contains both structural and feature information.



Graphic 7: **"Picture superiority effect" example – Berlin**

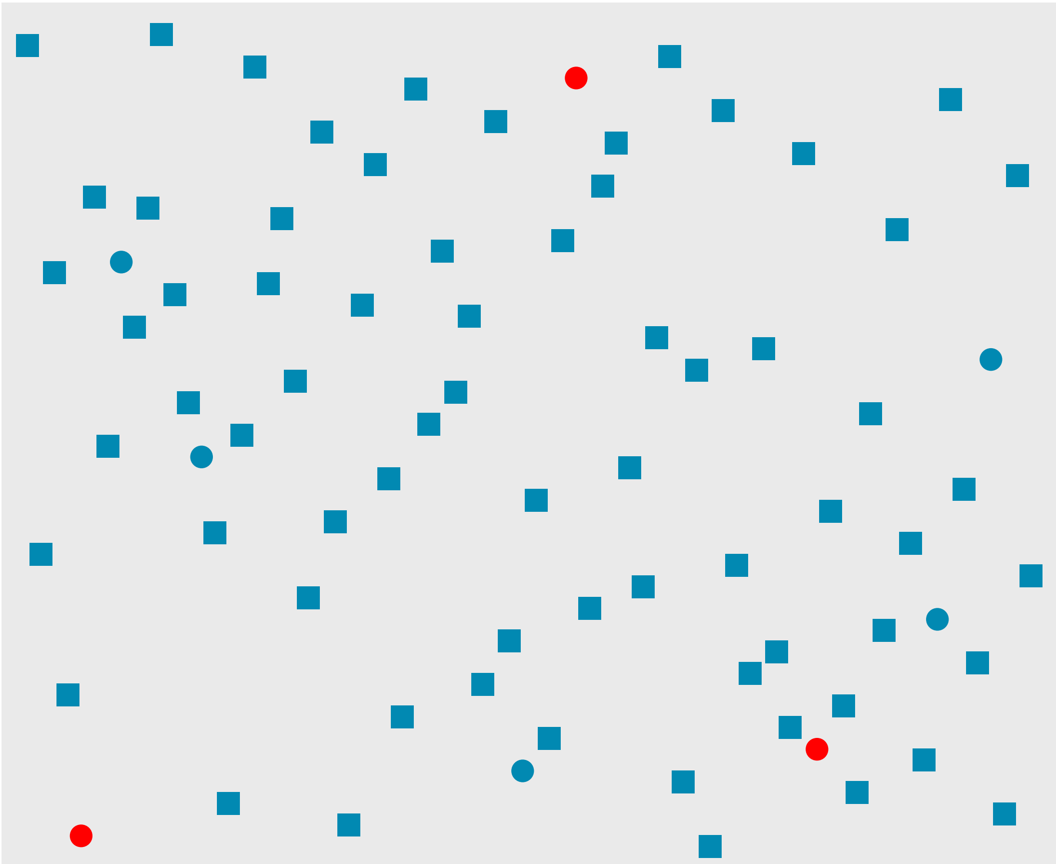
However, the verbal information itself is also encoded in the verbal memory in the form of linguistic sentences and the latter is thus activated.[29] Likewise, it is regarded that different regions of our memory support each other in both types of image processing – i.e., both structural and detailed – but are not dependent on each other in doing so.[30]

[29] cf. Kulvahy, Maps, p.52ff.

[30] Bestgen, Anne-Kathrin/ Edler, Dennis et al: Where Is It (in the Map)? Recall and Recognition of Spatial Information, in: Cartographica The International Journal for Geographic Information and Geovisualization 52 (2017), p.81.

Recent studies also support Kulvahy's thesis – mentioned in the previous section – that because of prior knowledge, one's ability to read a map is made easier and faster. In recent years, cartographic researchers, together with psychologists, have found through eye-tracking methods that maps are processed through visual perception by both so-called bottom-up encoding, which occurs through visual perception, and by top-down encoding, which involves cognitive processes. Bottom-up encoding means that visual information processing is activated by stimuli from outside and then processed by the brain. It therefore takes place at a pre-attentive stage and in early vision. For example, various visual map features can trigger visual stimuli in the recipient.

Top-down encoding, on the other hand, is related to the recipient's prior knowledge and how he or she uses it in perception, i.e., knowledge about how maps look, are constructed, what they are used for, and how they are used. This encoding function is thus based on knowledge stored in long-term memory.[31] So here again the familiar act of reading maps comes into play.



Graphic 8: **Weighting of color and form on a neutral background**

[31] cf. Griffin, Amy L.: Cartography, visual perception and cognitive psychology, in: Kent, Alexander J./ Vujakovic, Peter (ed.): The Routledge Handbook of Mapping and Cartography Routledge, London 2017, p.50f.

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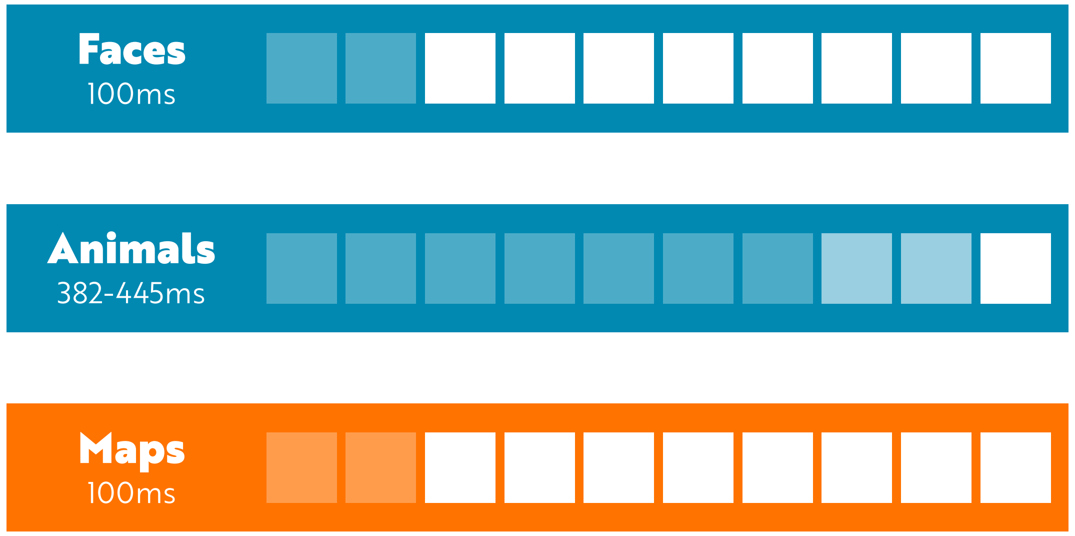
Other studies in recent years suggest that reading and understanding maps, which includes their spatial features and topographic information, is one of the most complex human skills. When perceiving or retrieving a map, a mental representation is produced, in which knowledge-controlled, as well as perceptual, processes take place. In these processes, the spatial information of maps is organized in a complex and hierarchical way in our memory, thus recreating a representation of the map.

The spatial information is used as a frame of reference in spatial memory and consists of the features of the map, such as structures, roads, landmarks, boundaries etc.



Graphic 9: **Image recognition example – maps** ☐ = 50ms

Thus, a hierarchical encoding of such information occurs, which in turn serves as visual anchor points, resulting in increased memory performance. Researchers led by Lars Kuchinke (2016) conducted an eye-tracking study on this topic, in which they found that image features, such as those present in maps, trigger automatic and immediate processing. Even if fixation of our eyes on a point or scene on the map has not yet occurred, processing begins. This happens within the first 100ms. Therefore, topographic details improved memory performance because they triggered deeper processing during encoding. In addition, the researchers found that the complexity of a map was also integrated into the mental representation of the map, allowing the recipient to remember in detail the maps that were presented.[32]

[32] Kuchinke, Lars/ Dickmann, Frank et al: The processing and integration of map elements during a recognition memory task is mirrored in eye-movement patterns, in: Journal of Environmental Psychology 47 (2016), p.213-222.

Graphic 10: **Weighting of color on a map**

Furthermore, many different theories, including psychological ones, have been written about how best to design maps to achieve the communication goal. Visual variables that are pre-processed by the eye-brain system have been explored. The form of processing results in individual features of the map catching the recipient's eye directly and being retained without the need to review each individual symbol on the map.As an example, dots marked in red are more likely to stand out on the map than blue dots. Maps that reduce the recipient's cognitive load are even more successful. They direct the recipient's attention specifically to the most informative part(s) of the map, which the recipient recognizes and understands with minimal effort. Under this premise, maps can thus also be created as support for specific tasks that can be understood quickly.[33]

[33] cf. Griffin, Cartography, p.46f.

6. Conclusion

This white paper shows that image perception takes place significantly faster than the perception of texts and words. Images can be recognized, processed, understood and also stored longer. An image can be recognized and processed within approximately 150ms. If a recipient is presented with an image for one to two seconds, it can be processed quickly and remembered for a long time. In the same amount of time, the recipient can only absorb about five to seven words, which are poorly remembered.

In particular, geographical maps offer even more added value in contrast to pictures and illustrations. From an early age, we come into contact with them, know how to read them, orient ourselves with them and understand them. It is innate in us; dealing with maps comes easily to us. Reading and understanding maps is a familiar act, we can actively perceive maps within 100ms.

By combining text (e.g. street names and locations) and visuals – i.e. topographical details – as well as structure and features, significantly more anchor points are created for the recipient. Dual encoding and overall memory performance is increased, allowing maps to be understood and absorbed within seconds, greatly improving the memory performance of maps. When maps are presented in conjunction with text, studies show they increase the memorization and recall of this textual content.

All in all, maps create sustainable added value, trust and connections.

7. Literature

Bestgen, Anne-Kathrin/ Edler, Dennis et al: Where Is It (in the Map)? Recall and Recognition of Spatial Information, in: Cartographica The International Journal for Geographic Information and Geovisualization 52 (2017), p.80-97.

Engelkamp, Johannes: Gedächtnis für Bilder, in: Sachs-Hombach, Klaus/ Rehkämpfer, Klaus (ed.): Bild – Bildwahrnehmung – Bildverarbeitung, Wiesbaden 2004[2], p.227-243.

Engelkamp, Johannes/ Rummer, Ralf: Gedächtnissysteme. Memory Systems, in: Funke, Joachim/ Frensch, Peter A. (ed.): Handbuch der Allgemeinen Psychologie – Kognition, Göttingen 2006, p.307-315.

Faas, Thorsten/ Arzheimer, Kai (ed.): Information – Wahrnehmung – Emotion. Politische Psychologie in der Wahl- und Einstellungsforschung, Wiesbaden 2010.

Griffin, Amy L.: Cartography, visual perception and cognitive psychology, in: Kent, Alexander J./ Vujakovic, Peter (ed.): The Routledge Handbook of Mapping and Cartography Routledge, London 2017, p.44-54.

Kent, James Alexander: Form Follows Feedback: Rethinking Cartographic Communication, in: Westminster Papers in Communication and Culture 13 (2018), p.96-112.

Kuchinke, Lars/ Dickmann, Frank et al.: The processing and integration of map elements during a recognition memory task is mirrored in eye-movement patterns, in: Journal of Environmental Psychology 47 (2016), p.213-222.

Kulhavy, Raymond W./ Stock, Wiliam A./ Kealy, Wiliam A.: How Geographic Maps Increase Recall of Instructional Text, in: Educational Technology Research and Development 41 (1993), p.47-62.

Levie, Howard W./ Lentz, Richard: Effects of Text Illustrations: A review of Research, in: Educational Technology Research and Development 30 (1982), p.195-232.

Mallot, Hanspeter A.: Visuelle Wahrnehmung. Visual Perception, in: Funke, Joachim/ Frensch, Peter A. (ed.): Handbuch der Allgemeinen Psychologie – Kognition, Göttingen 2006, p.127-137.

Marieb, Elaine N.: Human Anatomy and Physiology, California 1989.

Nelson, T.O./Metzler, J.: Role of Details in the Long-Term Recognition of Pictures and Verbal Descriptions, in: Journal of Experimental Psychology 102 (1974), p.184-186.

Nelson, Douglas L./ Reed, Valerie p./ Walling, John R.: Pictorial superiority effect, in: Journal of Experimental Psychology: Human Learning and Memory 2 (1976), p.523-528.

Schmidt, Thomas/ Haberkamp, Anke/ Veltkamp, G. Marina/ Weber, Andreas/ Seydell-Greenwald, Anna/ Schmidt, Filipp: Visual processing in rapid-chase systems: image processing, attention, and awareness, in: Front Psychol. 15 (2011). Doi: https://doi.org/10.3389/fpsyg.2011.00169

Thorpe, Simon/ Fize, Dennis/ Marlot, Catherine: Speed of processing in the human visual system, in: Nature 6 (1996), p.520-522.

Vaterrodt-Plünnecke, Bianca/ Bredenkamp, Jürgen: Gedächtnis: Definition, Konzeptionen, Methoden. Memory: Definitions and Methodological Approaches, in: Funke, Joachim/ Frensch, Peter A. (ed.): Handbuch der Allgemeinen Psychologie – Kognition, Göttingen 2006, p.297-306.

Weidenmann, Bernd: Psychologische Ansätze zur Optimierung des Wissenserwerbs mit Bildern, in: Sachs-Hombach, Klaus/ Rehkämpfer, Klaus (ed.): Bild – Bildwahrnehmung – Bildverarbeitung, Wiesbaden 2004[2], p.243-255.

Zhu, Weina/ Drewes, Jan/ Peatfield, Nicholas A./ Melcher, David: Differential Visual Processing of Animal Images, with and without Conscious Awareness, in: Frontiers in Human Neuroscience 10 (2016), Art.Nr. 513.

https://trends.google.com/trends/explore?date=2004-01-01%202021-01-18&q=maps (Retrieved on: 01-18-2021)

https://www.phrases.org.uk/meanings/a-picture-is-worth-a-thousand-words.html (Retrieved on: 01-19-2021)

https://www.br.de/radio/bayern2/sendungen/kalenderblatt/0812-ein-blick-sagt-mehr-als-1000-worte-102.html#:~:text=%22Ein%20Bild%20sagt%20mehr%20als%20tausend%20Worte%22%20hei%C3%9Ft%20es%20im,Jahre%2C%20wird%20als%20ihr%20gro%C3%9Fer (Retrieved on: 01-19-2021)

THE POWER OF MAPS

About the Author

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Jasmin Scheurich studied German and History at the *Christian-Albrechts-University zu Kiel*, Germany. Prior to joining locr in 2020, she worked several years for a welfare organization in which she gained her first experience in marketing and public relations. Her passion for writing, design and science has followed her throughout her life.

Based on her experience in the field of psychology and pedagogy from her studies, her interest in the effects of pictures and maps and due to the thought-provoking impulse of a colleague, the idea for this white paper was born.

About locr

locr is the world's leading provider of geomarketing solutions that let marketers use location to their advantage. locr takes data from leading geo-data suppliers and converts it into geo-information services and personalized maps that can be used by marketers to enhance their mailing lists, create higher engagement and achieve better response rates.

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