International Journal of Geo-Information

MDPI

Editorial

Cartography and Geomedia in Pragmatic Dimensions

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Abstract: This article summarizes the Special Issue of *Cartography and Geomedia.* Here, *Cartography and Geomedia* presents a view of cartography as a combination of technology, science, and art, with a focus on the development of geomedia in a geomatic and design-based context. Individual considerations are presented according to the following topics: efficiency of mapping techniques; historical cartographic works in a geomedial context; cartographic pragmatics for cultural heritage, teaching, and tourism; and pragmatism in gaming cartography. The main conclusion is that the two approaches to learning, revealing, and understanding geographic phenomena—starting from a specific geographical phenomenon and starting from maps and geomedia to understand geographical space—have their pragmatic strengths.

Keywords: cartography; geomedia; pragmatics; cartography in virtual space; symbol efficiency of visualization; information potential of geomedia; map; cartographic symbol

Citation: Medyńska-Gulij, B.; Forrest, D.; Kersten, T.P. Cartography and Geomedia in Pragmatic Dimensions. *ISPRS Int. J. Geo-Inf.* **2023**, *12*, 326. https://doi.org/10.3390/ijgi12080326

Received: 30 July 2023
Accepted: 1 August 2023
Published: 4 August 2023

1. Introduction

If geography describes geographic space, and cartography illustrates this space, one can identify the media that both disciplines use to transfer knowledge: text, photography, graphics, animation, video, sound, music, virtual environments, and computer games, among others [1]. Geomedia are therefore means of transmitting information about geographical space that the creator uses separately or jointly. *Cartography and Geomedia* holds the view of cartography as a combination of technology, science, and art, with a focus on the development of geomedia with regard to geomatic and design aspects. Modern cartography applies analogue, digital, and virtual maps, visualizations, and media to objects and landscapes, the evolution of map design, events in the historio-geographical space, topographical change representation socioeconomic transformations, geomedia for teaching, pragmatic geo-applications, social media, and immersion in geographic space, among others. In the context of *Cartography and Geomedia*, we can take two approaches to learn, reveal, and understand geographic phenomena. The first starts from a specific geographical phenomenon and searches for contemporary maps, historic maps, topographical and statistical visualizations, and other uses geomedia to describe and explain this phenomenon. The alternative starts with maps and geomedia to understand historical and contemporary geographical space. In this study, we focus on the use of individual media as information carriers in the context of the role of a map or cartographic symbols as the core of a pragmatic geomedia product. This Special Issue on *Cartography and Geomedia* takes a broad approach to the complementarity of cartography and geomedia, showing how many different problems may be addressed.

2. Efficiency of Mapping Techniques

Ban and Kim [2] propose a new application for the relative motion analysis and visualization of maritime traffic in space and time. They argue that an ideal maritime

traffic control system should implement specific characteristics, including knowledge of the relative motion of vessels in the same areas, to support navigators in decision making. User evaluation shows it is crucial to apply the principles of cartographic symbolization for the effective visualization of the navigational information of many vessels to effectively support the maritime traffic control system.

The study by Wielebski and Medyńska-Gulij [3] yield interesting results based on research concerning six thematic maps made with various mapping techniques and related to various aspects of the activities of rescue helicopters. Users ranked these maps in terms of four subjective evaluation criteria, which were the graphical attractiveness of the maps, the readability of the maps, the usefulness and importance of the information, and the complexity of the information presented on the maps. In the case of the usefulness and importance of the information, the map's topic—important for saving health and life from the user's point of view—was of the greatest importance, while the amount of information in the legend significantly influenced the evaluation of information complexity.

Eye tracking tests are of great importance for checking the effectiveness of geomedia designs. Cybulski [4] apply eye-tracking in a controlled laboratory experiment with 15 animated choropleth maps illustrating various spatial and temporal changes. The results of this experiment show that effective pattern or trend recognitions can be influenced by user' visual behavior, but animated choropleth maps are more suitable for presenting temporal trends than spatial patterns.

An interesting example of the parametric modeling method for 3D symbols in geology is Li and Chen's proposal [5]. According to the complexity and diversity of the fold structures, they discuss the generation of 3D fold symbols which abstractly express the morphologies of fold structures developed in the experimental area and can express most fold structure subdivision types. The parametric modeling method for the 3D symbols of fold structures follows the traditional cartographic symbol creation rules, but the modeling method avoids excessive dependence on geological survey data, and fits well with the abstract character of the geological symbol.

Research by Lyu et al. [6] suggest that cartographic generalization of road networks cannot be considered in isolation as there is a strong geographical correlation between roads and settlements. They describe a method for generalizing a road network, with settlements as nodes, which removes redundant paths between settlements and verifies the visual continuity and topological connectivity of the network.

3. Historical Cartographic Works in Geomedial Dimension

In a new methodological approach, Medyńska-Gulij et al. [7] employ a complementary combination of the knowledge of historical geography, map design principles, general good practices of writing a short film script, and the use of media. In one shared video, they use as many different types of geomedia as possible to tell a story, e.g., historical printed maps, digital political maps, hypsometric maps, old maps, 3D maps, and cartographic animations. They offer potential designers recommendations for filming historical geography with analog maps and maps created specifically for films published on online video-sharing and social media platforms.

Justová and Cajthmal [8] develop a process for adapting originally printed historical maps for presentation online which goes beyond zoomable, scanned analogues or default GIS maps. They discuss how the additional functionality the new geomedia dimension of these historical maps on the web allows for the simplification of the originally complex map and to increase the information potential of the maps. They go onto set out a complex methodology for effective presentation of printed historical maps on the web.

Globes are a special cartographic product, but cannot simply be scanned or photographed like a flat map to create a digital visualization. Stefanova et al. [9] develop a model for creating a virtual copy. In this process, the key aspects in digitizing the globe were the appropriate photogrammetric parameters, new metadata from the bibliographic description, the specificity of the old engraving in the copperplate, and web presentation.

They also compare web browsing performance and offer good practice guidelines that can be applied more generally.

The selection of appropriate geomedia attributes for constructing natural and suggestive perspective visualizations can be a new option for 3D digitizing historical watercolor topographic maps. Medyńska-Gulij [10] selected several 18th century manuscript maps with specific painterly means of expression, which she subjected to rectification and vectorization of contour lines, and the transformation to a GRID model. After applying parameter variations such as elevation rise, azimuth and altitude, contrast of illumination, and the creation of the final bird's-eye-view visualization, she concludes that the proposed parameters for the three maps work well for creating the general static bird's-eye-view visualization, with the natural and suggestive perception of the landscapes' relief. However, it is crucial to maintain their complementarity.

4. Cartographic Pragmatics for Cultural Heritage, Teaching and Tourism

An example of using cartographic methods in cultural heritage research is identifying relatively stable boundaries of dialect and subdialect areas, allowing language surveys to focus on boundaries. Duan and Zhou [11] note that scholars often use the watershed boundary as the boundary of dialect areas. In the Tibetan case they discovered that road breakpoint lines and other features can be reliable and effective indicators in determining the boundaries of (sub)dialect areas, and that such data can highlight issues with language survey samples.

In order to promote the rich cultural and natural heritage of an area to tourists not aware of it, Luppichini et al. [12] propose the use of Web Mapping and Real–Virtual Itineraries based on geological, biological, and archaeological data. Based on a multidisciplinary approach, they create palaeoenvironment maps and real and virtual itineraries with the aid of a web application, more specifically web mapping, developed with free and open-source libraries.

Due to their text-based presentation, local chronicles recording the urban characteristic and culture of a location are limited in their accessibility and geographical context. He et al. [13] create visualizations of city-specific culture extracted from local chronicles is based on designing various types of content-framework construction with the most important being the cartographic approach. Evaluation of the four sample designs shows that despite some limitations resulting from the size and content of the chronicles, it is possible to integrate local chronicles with maps to create meaningful visualizations of spatial and temporal connections. The case study can be treated as a universal model for creating visualizations of cultural, didactic, and touristic significance.

A similar cultural and teaching dimension is found in the considerations of Janovský et al. [14] concerning the development of a visualization of a historic river valley before the construction of the so-called Vltava Cascade. Historical cadastral maps were the input data for creating a virtual reality (VR) application using Unreal Engine software. Digital transformations and programming result in 3D scenes in a form approximately corresponding to the state of the river valley in the 19th century, which is available for viewing via a web application, and a VR scene used for demonstration at exhibitions for a wider audience.

Creating a virtual tour of the site of an onshore wind farm can be counted as a specific use of stitching images with multi-row panorama and multimedia sources. Lai et al. [15] propose improving image stitching quality by calculating the root mean square error (RMSE) of tie point matching and adjustment. Once the images are stitched together effectively, they are combined with multimedia materials to provide information on wind turbine attributes to establish a virtual reality tour platform accessible on a smartphone.

Mercier et al. [16] describe a comparative test to assess system usability and understand the impact of different geolocation techniques on the usability of Augmented Reality (AR) applications. Their cartographic authoring tool for the visualization of geolocated media in augmented reality (AR) has been tested to extend education technology towards

biodiversity education. The use of the UCD method (User-Centered Design) allowed for adaption to the needs and expectations of teachers and students. However, the variable positional accuracy of mobile devices is an issue. While an external RTK (Real-Time Kinematic Positioning) module solves the problem of geolocation data inaccuracy, without its usability, issues remain.

Halik and Wielebski [17] suggest a new method of generating AR with a new name plane-based augmented geovisualizations (PAGs). Based on the embedding of several models of mountain peaks, they tested them as geovisualizations on any plane detected with the AR device. Three age groups of users pointed out that the AR mode was preferable against all compared criteria; only with regard to the criterion of ease of use of the AR mode, was the result less definitive.

5. Pragmatics in Gaming Cartography

Gaming cartography is a developing trend in geomedia research. Therefore, in this Special Issue, there are studies which feature players' opinions about the characteristics of cartographic symbols and the interface and the use of maps in games.

Medyńska-Gulij et al. [18] investigate map design and usability issues when exploring topographical space in landscape versus portrait orientation in mobile phone games. The study incorporated an appropriate research methodology, including establishing conceptual assumptions, developing map applications with gaming elements, user testing, and visualizing results. The results reveal the main differences and similarities in participant performance when using a simplified topographic 2D Map. The different phone orientations solicited different visual strategies, which in turn influenced decisions regarding path selection.

Based on the analysis of 100 popular video games, Zagata and Medyńska-Gulij [19] identify features of mini-map design used as navigational support in the virtual geographical space. The analytical study revealed eight features of mini-map design and their popular parameters and attributes: projection—orthographic; centering—player-centered; base layers—artificial; shape—circular; orientation—camera view; position—bottom left; proportions—2–3%; additional navigational element—north arrow. They are able to confirm the feasibility of designing a mini-map according to traditional cartographic design principles when these attributes were considered separately, complementarily, and holistically.

The interpretation of app symbols in the context of gamers' age and experience is investigated by Horbiński and Zagata [20]. Using a popular survival game as their focus, they explored the effects that players' age and the time spent playing has on their interpretation of map symbols used in a game. Based on the outcomes of the study, it is concluded that there is correlation between the age of the players, the time spent playing, and the interpretations of symbols within it (for individual symbols but not the entire symbol set).

6. Conclusions

Critical reflections on deviance in representation—in the context of the relationship between aesthetics and cartography—is a key aspect of the discourse on the relationship between cartography and geomedia. Edler and Kühne [21] treat cartographic representations as being subject to sensory perception, and these representations rely on the translation of sensory perceptions into cartographic symbols. On the one hand, Edler and Kühne accept traditional cartography, on the other hand, they see great potential in augmented and virtual environments to generate aesthetically constructed cartographic representations.

The studies presented above show the increasingly strong links between cartography and geomedia—as it is broadly understood—in primarily pragmatic terms. It is worth noting that maps and cartographic symbols are the elements that bind the representation of geographical phenomena in new media. Additionally, the adaptation of cartographic forms to the virtual environment creates new opportunities for the visualization of space

using photogrammetric and geomatic techniques [22] as well as the design–programming approach [18].

Considering the above mentioned studies, we can conclude that the two approaches to learning, revealing, and understanding geographic phenomena—starting from a specific geographical phenomenon and starting from maps and geomedia to understand geographical space—are advantageous. Starting from a specific geographical phenomenon and using maps and geomedia to understand geographical space focuses on the pragmatic dimension [23]. Cartographic pragmatism which emphasize the principles of map design, is highly advantageous, because it guarantees the effectiveness of the transmission of quantitative and quantitative geographic information [24].

Author Contributions: Conceptualization, Beata Medyńska-Gulij, David Forrest and Thomas P. Kersten; methodology, Beata Medyńska-Gulij, David Forrest and Thomas P. Kersten; writing—original draft preparation, Beata Medyńska-Gulij, David Forrest and Thomas P. Kersten. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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