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PARTICIPATORY DEEP MAPS: TOWARDS DISCURSIVE USER ENGAGEMENT WITH DATA VISUALIZATIONS

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1. BACKGROUND

This paper introduces the concept of deep participatory maps, an approach to democratizing the way local knowledge is collected, shared, and discussed using interactive data visualizations. While geovisualizations provide a useful frame of reference for mapping spatial data and local knowledge, generally, they remain artifacts of a unidirectional creation and communication process: from the data source to the audience. This process is curated by the cartographer, visualization designers, or any other author. Typically, this results in a singular perspective onto the underlying data and the represented issues.

In this paper, we propose *participatory deep maps* as a promising approach to multilayered geovisualization to allow for polyvocal and participatory mapping. It provides mechanisms for annotation, discussion, data collection, storytelling and other activities of participation. Deep maps have traditionally been described as conceptual maps that "include the discursive and ideological dimensions of place, the dreams, hopes, and fears of residents" [17]. Here, we are interested in the participatory potential of such deep maps. Our observations are based on a literature review on tools for map annotations, revealing common patterns for participation and annotation. Also, we're motivated by four cases from current collaborations in the fields of peacemaking, population demographics, and street ethnography that seek for participatory mapmaking. We finish with a set of challenges for studying and designing participatory deep maps. Our discussion has implications beyond geovisualization and potentially applies to data visualization more generally.

2. MOTIVATING CASES

In recent research projects, we have encountered the need for novel forms of geovisualizations that allow for participatory and polyvocal mapping. In the following, we briefly describe these cases as motivations for our work with participatory deep maps.

Mapping local opinions: In a previous project [10], we compared various ethnographic methods on a street-level to produce local knowledge. Go-along interviews as well as intercept surveys unearthed diverging spatial narratives: there was no consensus about the character of a street among its residents, but rather a complex and entangled meshwork of opinions, anecdotes and feelings. *One problem throughout the study was the visual representation of these georeferenced, yet largely unstructured and highly opinionated data. Through deep participatory maps, we imagine interfaces that allow citizens to directly annotate streets and regions to express a wide range of opinions and thoughts, either following an ad-hoc survey or as part of an openended and ongoing mapping process.*

Mapping peace and conflict: In a recent workshop on the use of digital tools and data visualization to support inclusive peace processes in conflict regions [7], we identified the need for mapping location, time, and extent of violence: armed conflict, explosions, remote attacks as well as related indicators such as blocked streets and electricity outages. In most cases, a complete view of such a situation is impossible due to incomplete data, dynamic changes, subjective opinions, and contrary interests. We believe, this requires integrating existing datasets from news

sources, public sources and other databases. *Currently, integrating diverse data sources is a painstaking and highly technical process but we want to imagine lightweight interfaces for selective and manual integration and visualization. Specific visualization problems include uncertainty and possibly contradictory information in these sources.*

Mapping personal stories: In the same workshop, it was called for visibility of personal stories in conflicts. One participant stated that "the first part of transitional justice is being heard." Existing maps lack a feedback channel for people to situate themselves in a visualization and contribute their own experiences, stories and other types of local knowledge. *Thus, it is of high importance that participants can express their opinion, contribute data, enrich the maps with personal data and potentially create and share their own visualizations easily.*

Mapping social frontiers: Ongoing research on social frontiers— "places of sharp difference in social/ethnic characteristics between neighbouring communities" [4]— is based on available census data. There is high demand to examine, how social frontiers in the data relate to residents' knowledge about neighbourhood boundaries as well as data and insights generated by other researchers. *Backchanneling this knowledge to researchers can provide meaningful explanations on the emergence of social frontiers and help develop strategies to aggregate these data.* As an example, census data has limited granularity since it is aggregated within existing administrative boundaries. Cohesive social territories do not necessarily follow these boundaries. Finding ways to incorporate residents' subjective perception of neighbourhood boundaries (e.g., by letting them draw on a map) can provide a link between observations in data and explanatory context.

3. RELATED WORK

We now review tools and interfaces, currently able to partially support participation on maps in our motivating cases. These include methods for collaboration and communication in the context of information visualization and mapping. Our participatory maps are asynchronous and distant cases, in the words of the CSCW-matrix [9]. Respective visualization interfaces have been equipped with techniques to comment, graphically annotate, and discuss different states of the visualizations [8, 16]. While in these cases, annotations and discussions primarily aimed at the generation of hypotheses and collaborative sensemaking [19], people also provided contextual knowledge about the data at hand, such as insight on the data, detected patterns and different interpretation levels [15]. Participatory maps aim to take these annotations on step further by providing more customized mechanisms for annotation and expression.

Established map services like Google Maps or Open Street map (OSM) offer a small range of tools like markers with comments and individual icons to depict locations, paths, and zones, and share them with others. On OSM, users can suggest edits or disagree with the position or classification of geographic features, consequently triggering a process to correct supposedly wrong information. Other mapmaking and visualization platforms implement features to display geo-references annotations and callout lines.[1][2] StorymapJS can create annotated links between locations that allow for the narration of place-based stories through time.[3]

Other tools allow for more public participation: With Hoodmap[4], users can classify quadrants of a city according to pre-defined categories. A Swiss newspaper[5] invited it's readers to guess the Swiss border on a map with only two major cities as orientation. The actual border and the collective drawings of all readers were then shown, revealing different levels of effort and knowledge.

Storytelling with maps is common in infographics and news outlets including techniques such as small multiples, highlighting, callout lines, specific symbols, or local insets as shown in atlases and potentially data comics [3]. In interactive visualizations, incorporating the audience as part of the story is an established way of fostering engagement [2]. However, participation here refers to pre-scripted exploration, rather than open-ended participation, question-asking and sharing of opinion.

PPGIS [12] has a standing history in the representation of decentralized spatial knowledge. It's emergence represents a milestone in challenging the one-sidedness of digital maps. Therefore, it demonstrates the impact that participatory features can have on spatial representation. Another, more political demonstration of this is the

[1]https://blog.datawrapper.de/locatormap-calloutlines/
[2]https://flourish.studio/examples/
[3]https://storymap.knightlab.com
[4]https://hoodmaps.com/edinburgh
[5]https://www.nzz.ch/storytelling/geografie-kenntnisse-wie-gut-koennen-sie-die-schweiz-aus-dem-gedaechtnis-zeichnen-ld.1306768

anti-eviction mapping project (AEMP) [14], a countermapping platform in the tradition of critical cartography. It depicts a powerful collection of maps, visualizations and most importantly oral history of places to document the process of gentrification in the San Francisco Bay area and the resistance against it. Juxtaposing these approaches reveals a major difference on how they deal with a multiplicity of narratives: PPGIS platforms seek to minimize "the structural knowledge distortion" [18] by consolidating the rich knowledge base of a community into mapable geographic entities. AEMP on the other hand scatters them across different maps without connecting them among each other.
What is missing is a single platform that allows for a co-existence of a multiplicity of spatial narratives in one map and interfaces to collect and share them.

4. CHALLENGES

Motivated by the existing cases and a first review of existing work, we identify six challenges for the design and implementation of participatory deep maps:

Personal stories: Map visualizations provide a base to tell stories, i.e. narratives that tell personal views or explain what is visualized and the data's context. *We could not find any interfaces that go beyond annotation, markers, and websites of map pictures but to provide more customized interactive and engaging versions for storytelling such as videos [1] or data comics [11].*

Integrating additional data: One simple and often practised way of data integration is linking to external resources. However, Drucker criticizes the incapacity of conventional interfaces to "alter data structures of a visualization through direct input" [6]. Building interfaces that allow an audience to augment the underlying data with own perspectives and provide for an immediate visualization of them is a yet unsolved task. This challenge involves the design of user interface elements as well as embedding these elements in an user experience that invites for contributions. Another question that is to be answered is the appropriate anchor and scope of augmentations: Does an audience discuss geographical points, data points, visual marks, or other existing authored contributions? How can an integration happen technically? How can it be achieved visually and without cluttering the map?

Fostering & visualizing discourse: Typically, there is no consensus about what, where, when, and why something happened: contributions from different authors can question, augment, comment, or disagree with the data or other authors' perspectives. Existing interface design patterns have limited ability to represent this multiplicity. Therefore, one central challenge is to draft design patterns for participation in discourse. These patterns should work towards "exposing multiple facets and enabling a variety of interpretations" [5] of the data and the discourse around it. Moreover, we need to find effective forms to visualize these data alongside the original map to highlight places and areas with agreement and disagreement, which types of contributions exist, how the contributions are related, which topics are discussed, which places are related in a single narrative or through all the narratives.

Moderation: Human or automated moderation can solve problems related to the potentially unstructured and open nature of data from participatory processes such as ambiguity, disagreement, incomplete data, or wrong data. Central moderation by a single authority can be a reliable way but can also introduce bias towards that authority's stance. Implementing bottom-up mechanism for content visibility, i.e. voting systems, averages, trust-networks) could address this issue, but would also promote a mainstream narrative over a silenced voice. To the best of our knowledge, no such structures have yet been explored and designed for data visualization.

Fostering engagement: In order to participate, the audience needs incentives. Personal visibility, advocating for once's opinion, fun, or monetary rewards can inform engagement strategies. However, engagement goes further by calling for ways to author, serialize and share local knowledge across different media and social groups.

Analyzing participation: The audience's information and interactions are a rich source of data about a given topic. Eventually, these data can—if collected according to existing data protection laws—give insights into disputed areas, ways in which information is discussed, collaboration strategies, the level of visualization literacy and trust with data visualizations, as well as a rich source of unstructured data about local and other forms of knowledge relevant to the visualization or the topic [13].
We need to develop tools and methods that allow us to understand

participation with map visualizations to understand how we can improve both the visualizations, visualization interfaces, and their explanation.

5. CONCLUSION

We believe that addressing these challenges is non-trivial and instead requires better user and visualization interfaces as well as as codes of collaboration. The presented cases are an entry point and can serve as a fertile medium to rise up to these challenges and explore the inclusive potential of visualization.

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