TOWARD DREAM CARTOGRAPHY: MAPPING DREAM SPACE AND CONTENT

Cristina M. Iosifescu Enescu*, Jacques Montangero**, Lorenz Hurni*

*Institute of Cartography and Geoinformation, ETH Zurich, Switzerland  
**Department of Psychology, University of Geneva, Switzerland

Abstract. The objective of dream cartography is to map dream content, that is, to develop new visualization methods and adapt existing ones as graphical means for an explorative dream analysis. We aim at modelling, documenting, reuniting, and graphically depicting the dream space and other relevant psychological aspects of dreams in a meaningful but abstracted way. In this article we describe the proposed workflow for mapping dreams, focusing on data acquisition, and illustrate it with some proof-of-concept visualization examples. The dream space is fundamentally different from the real space, especially because it is not possible to consciously visit the place of the dream again. One way to address this setting issue is through data acquisition, and here we propose means for getting a more accurate description of the dream space and of other important dream elements.

Keywords: Dream Cartography, Dream Space, Condensed Places, Data Modeling, Cartographic Information Systems

1. Introduction

Cartography describes places and spatially distributed phenomena graphically, using symbolization. Psychology is based on the description of people’s behavior and mental content. Dream Cartography brings cartography and psychology together, in order to get new insights, through cartography, on the subject dream. Dream is a topic that concerned generations of psychologists and is still a broadly active research area nowadays. How do dream elements (places, social interactions, emotions, goals, etc.) look like, how do they differ from the real life? Dream space, especially, presents a cartographic challenge because of its particularities: not only geographical locations are dreamed about, but also places that are mixed (which reunite distinct features of different places), condensed (as mixed, but embedding also different personal experiences and thoughts), distorted (spatial proportions are different than in reality), uncertain or totally invented. Moreover, social interactions, dream storyline and emotions, to name just a few, are important psychological aspects, which contribute to the complexity of the inner-world to be mapped.
In this context, Dream Cartography proposes the development of new visualization methods and adaptation of existing ones for dreams in order to create maps for mixed, condensed and distorted places, map uncertain geodata, visualize relative position respectively graphically represent time flow and character occurrences, social relationships or valence / emotions arising in dreams. The goal is to integrate all these visualization elements into an interactive Web platform, so that each dream presents itself to the map viewer in its actual multidimensionality. Our project targets especially dream researchers and psychology scholars, as well laymen interested in their dreams.

The cartography of dreams opens up new dimensions of research, in the domain of classical cartography, GIS and of psychology. The first scientific relevance is in cartography, since this means exploring new, undiscovered territories, creating very specific, individual maps and proposing novel symbolization. The insights that we gain from the visualization of the spatial dimension of dreams may be used to visually represent other data or descriptions of places, as the surrounding world is interpreted by human cognition. The latter might be used in location-based services in order to improve for example verbal instructions for navigating to unknown places.

From the point of view of psychology, we add our cartographic contribution to the cognitive theory of dreams, where the manifest content of dreams has significance in itself. Accordingly we can provide a user-friendly, graphical tool for exploring the dream storyline and landscape, allowing end-user to adapt the visualization in order to reflect the importance of the occurring elements in the dream. Dream Cartography can serve as an important analysis tool for psychologists and psychiatrists who may explore individual dreams and dream series of their patients for discovering patterns in the dreams, such as reoccurring places, emotions, type of characters or of social interactions.

In this paper, we first state the problem of space creation in natural language, then give some compact background information about dream research and continue with the embedding of dream cartography into state of the art cartographic research. We finally sketch the workflow of producing dream maps based on some given examples and outline the most challenging aspects of this process that require further investigation.

2. Setting as a Basic Construct in Dream Cartography

The debate on the meaning and understanding of space versus place and the creation of place as the space directly experienced by people is addressed in human geography by Tuan (1977) and later by Cresswell (2013). Furthermore, Dennerlein (2009) analyzes how the space/place/setting is narrated and what elements are needed for a place to be defined in a literary text. It is known that human cognition of space is different from Euclidian geometry (Frank, Mark, and Raubal 2013). How people perceive space and time and, subsequently, how they refer to these, is the subject of naive geography, defined as “the body of knowledge that people have
about the surrounding geographic world” (Egenhofer and Mark 1995, 4). Therefore, spatial (and temporal, for that matter) relationships can be absolute, relative and intrinsic (Tenbrink and Kuhn 2011). Concerning the topic of dreams, Forshage (2007) addresses the issue of “how space is constructed” in dreams, using identifiable criteria from “natural phenomena (flora, fauna, geomorphology, meteorology, etc.)”. Related to his novel, a Swedish non-scientific community makes interesting observations on spatio-genesis in dreams (“The Landscape of Our Dreams - Foundations of Dream Geography” 2011) and names superordinate aspects of the spatial phenomenology such as the geometry and structure of the dreamscape, the spatial relations, the means of recognition and orientation (e.g. what signs are used for recognizing a place: signposts, spoken language, infrastructural characteristics, etc.), active integrative learning from dream abilities, experiences and solutions (e.g. “solving practical problems by rearranging spatial relations”). Indeed there are “different geographies” and, starting by mentioning the London Underground Map from Beck, 1931, that modified the real geography to help navigation into the real space, the book “Mapping Different Geographies” (Kriz, Cartwright, and Hurni 2010) offers an overview of these, which, being removed from conventional maps, are nevertheless powerful tools of information for historical, cultural and artistic phenomena. An example of a “different geography” is the “literary geography”, which we discuss closer in the section 4.1.

The term of uncertain geodata was first introduced Geoinformation Science in order to take data quality into consideration when visualizing geodata (MacEachren 1992). For uncertain representations, an extended set of graphical variables are proposed: color saturation, crispness of symbols, transparency and resolution of raster geodata (MacEachren et al. 2005). The visualization of uncertain geodata is an important topic for instance in the emerging field of literary geography, where uncertainty is related more to the vagueness and subjectivity of data (Reuschel and Hurni 2011) than to the quality of input data.

In comparison, the work that has been done in the dream research community related to settings, on which the dreams take place, is mainly related to classifying these into indoor/outdoor or with respect to their familiarity to the dreamer (e.g. using the Hall and Van de Castle dream coding system; (Domhoff 1999). It has also been noted that a specificity of dream space, beside condensations of elements of different places in one dream location, is the selection of a few elements of a totality or the representation of one part of the setting only (Montangero 1999). This can make the same setting look different to different persons, which for example in computer gaming is called phasing.1

1 http://www.wowwiki.com/Phasing, accessed on 15.11.2014
3. **Dream Research: a Brief Overview**

Dreaming is defined as “a state of consciousness characterized by internally-generated sensory, cognitive and emotional experiences” (Desseilles et al. 2011) which occur usually during sleep, but also on so-called states of day-dreaming.

The most prominent approaches to the study of dreams nowadays are the Psychoanalytic Dream Theory and the Cognitive Approach to Dreams. The Psychoanalytic Dream Theory focuses on dream interpretation in the sense that the dreams disguise wishes but also reveal the way persons process conflict and emotion, cope with anxiety, their defense mechanisms or their creative potential (Freud 1900; Hau 2006). It is Freud who first proposed the term “condensation” in dreams, which he describes as the bringing together of different aspects of the dreamer’s experience into a single dream image (Freud 1900). The Cognitive Approach studies the form or content of dreams and explains these “with references to cognitive processes involved in waking and sleep mentation” (Montangero 2012b). Some cognitive studies are quantitative content analyses on large samples of dreams (Domhoff 1996; Strauch and Meier 1996); for example they specify the percentage of the studied dreams which take place indoor versus outdoor.

Other cognitive studies are more interested in dream processes and deal with qualitative aspects of dream content, such as the development of children’s dreams (Foulkes 1999), the narrative organization of the dream experience (Cipolli and Poli 1992; Montangero 2012a) or the nature of memory sources of dreams (Baylor and Cavallero 2001). According to researchers using a cognitive approach (Domhoff 1996), dreams reveal conceptions and current concerns of a person.

Apart from the dream research focusing on dream content, which we specifically consider for the current project, we mention the interest of neuropsychology in brain activation during sleep, respectively during dreaming (Nir and Tononi 2010). Neurophysiological (Electroencephalogram) and neuroimaging (Functional Magneto-Resonance Imagery) methods generate maps of brain activation. These visualize areas of the human brain in the attempt of understanding the dreaming process from the physiological point of view, which is fundamentally different to mapping the dream content as we propose in the current project.

4. **Integrating Dream Cartography into Current Cartographic Research**

The cartographic aspects of mapping dream contents cover the modeling of input data for an automatic generation of maps, the visualization of dream space with its specificities in the form of maps, the developing of comprehensive visualizations schemas (e.g. diagrams or network-like representations) for other dream variables and finally the integration into a cartographic information system, respectively an interactive, Multimedia Atlas Information System (Hurni 2008). In the following, we restrict our observations to current research on modeling and visualization of
uncertain geodata as addressed by the literary geography and to interactive Web platforms and Atlas Information Systems, which represents the way in which we intend to communicate dream maps to our target audience.

4.1. Literary Geography

Regarding the modeling and visualization of uncertain geodata, we mention the research work that has been done in the emerging field of the literary geography, which deals with the representation of space in fiction. In order to better represent the literary space, our colleagues from the project “A Literary Atlas of Europe” modeled the available space information into individual spatial entities according to their function: settings, zones of actions, projected spaces (which are located in a character’s mind, without the character being physically there), routes and markers (Piatti et al. 2009; Reuschel, Piatti, and Hurni 2013). Moreover, “settings and projected places with uncertain, transformed or hardly locatable spatial objects necessitate additional attributes and composed geometries respectively in order to reflect the fictional world” (Reuschel, Piatti, and Hurni 2013, 142–143). Therefore, and also for the depiction of the setting’s importance to the literary work, Reuschel et al. (2013) propose, beside the geometry, attributes such as the uncertainty degree (precise or zonal) and the relation to the actual geospace (imported, transformed – shifted or synthesized places, invented or imagined). These literary settings attributes can be adapted for classifying the importance of space in dreams as well.

For the cartographical representation of single spatial objects, the “Literary Atlas of Europe” uses symbols and labels to indicate the extent and the preciseness of the settings and color codes for the relationship between literary space and real space. Reuschel and Hurni (Reuschel and Hurni 2011; Reuschel 2012) propose visualization methods such as fuzzy shapes, animated or texture (radial) visualization for settings; diffuse Gaussian boundaries, fading in and out for routes and concentric circular arcs for uncertain routes’ start- or endpoints; shifted spaces are brought in connection to their true location using directed Bezier curves. Moreover, for some special cases both the current geography and the historical map from that time are displayed, which results in a better understanding of the novel’s spatial dimension.

Although the “Literary Atlas of Europe” is related to our proposed work regarding the modeling of spatial information and visualization of uncertain geodata, it deals only scarcely with mixed, condensed or distorted places. Along with dream setting, in Dream Cartography we take into consideration and visualize additional information such as the previously mentioned relevant psychological aspects of dreams, which are crucial in expressing the multidimensionality of a dream. Moreover, when the literary geography deals with fictional places (e.g. J.R.R. Tolkien), the text of analysis has a different scale, different narrative properties and places have an important feature, which dreams do not always present: stability.
4.2. Interactive Atlases and the Web

Multimedia Atlas Information Systems are “systematic, targeted collections of spatially related knowledge in electronic form, allowing a user-oriented communication for information and decision-making purposes” (Hurni 2008). These do not only combine high cartographic quality and user-friendliness with special interactive functions for geographic and thematic navigation, querying and analysis, but also enrich the user experience with multimedia information such as images, video and audio documents, animations, graphics and diagrams.

Furthermore, the Web as a communication medium had a great influence in changing maps from static entities into dynamic, interactive products (Peterson 2008). A way to integrate the power of atlas information systems with the Web is by using Web standards such as Hyper Text Markup Language (HTML), eXtensible Markup Language (XML), Scalable Vector Graphics (SVG) and Java Script/ECMA Script, whereas the cartographic representation on Web can, for instance, use the Web Map Service (WMS) protocol along with Styled Layer Descriptor (SLD) (I. Iosifescu Enescu 2011).

GeoVITe is an example of an interactive Web platform for providing researchers with an easy-to-use online access for visualization and download of geodata (C. M. Iosifescu Enescu, Iosifescu Enescu, Jenny, & Hurni, 2011). This platform was extended for other projects such as SwissExperiment/OSPER (Open Support Platform for Environmental Research), which enhances the visualization, among others, with time navigation and interactive, customizable symbolization of thematic data (C. M. Iosifescu Enescu, Iosifescu Enescu, and Hurni 2013).

The different graphical elements proposed by the Dream Cartography can be integrated into an interactive Web platform such as the one for GeoVITe, along with the actual feed of new dream reports into the database and so enhance user participation and let the explorative analysis of the dream data be most appealing. After this brief review of literature related to our work, we get into the more specific part of this paper, with the proposed workflow detailed in section 5 and some proof-of-concept visualization examples in section 6.

5. Mapping Dreams: Workflow

The workflow for Dream Cartography covers the following topics: data acquisition, data modeling, setting visualization and visualization of other psychologically relevant dream aspects, and, as a further objective, comprises the visualization of dream series of a person. Advanced data acquisition, a part of data modeling and the dream visualization make use of a specifically created and tailored Web GIS application, designed based on our previous experience with Web portals with customizable content and visualization (C. M. Iosifescu Enescu, Iosifescu Enescu, and Hurni 2013), as previously discussed in section 4.2.
5.1. Data Acquisition

In the process of mapping dreams, the question of how to collect dream data becomes a key issue. The dream research community uses mostly self-written dream reports (Nir and Tononi 2010). The other possibility, of getting people in a sleep laboratory and wake them up during the night in order to get a more “unbiased” dream story, is beyond the means of this work. Therefore our options are to work with available dream reports or to gather dream reports from willing participants. In the first option, dream databases (Domhoff and Schneider 2013) or dreaming groups organized online can provide a good starting source, and also valuable are published books which contain dream logs (von Uslar 2003). However, the latter option brings additional value in our case, for reasons of dream recording preparation (see Table 1), submission of fresh information, follow-up questions for details (see Table 2), but also for reasons of interactivity of the dreamer with project’s Web platform and therefore possible contribution in the cartographic representations, which we address in section 6. In the following we feature this targeted data acquisition method.

Every dream takes place in a setting, but sometimes the dream location is not mentioned in the dream report (see also section 2). Therefore, beside the simple submission of a dream report, we prepared a questionnaire (see Table 2) that reminds the participants about recording the dream location. Moreover, for the targeted acquisition of dream reports, the participants are given guiding instructions on how to keep a dream log, in order to get most of the dream content. Table 1 summarizes these instructions.
Table 1. Instructions for keeping a dream log

<table>
<thead>
<tr>
<th>Metadata</th>
<th>Instruction for the dreamer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation of the recording means</td>
<td>Prepare a computer file or a paper notebook if preferred, in order to write down the dream reports. Prepare also an audio recording means (mobile phone or audio recorder).</td>
</tr>
<tr>
<td>Choosing an un-stressful morning</td>
<td>Decide at which date you will attempt to recall and report a dream: a morning without time pressure, e.g., during weekends or holidays.</td>
</tr>
<tr>
<td>Self-preparation in the evening before</td>
<td>The evening before that date, when going to bed, give yourself the instruction: When I wake up tomorrow morning, I won’t move and I will immediately ask myself the question: What was on my mind just before I woke up?</td>
</tr>
<tr>
<td>Dream rehearsal</td>
<td>Upon awakening, if a dream scene is recalled, rehearse it (visualize and feel the other impressions of that dream scene again). This and the following instruction are to be completed before moving, getting up and switching the light on.</td>
</tr>
<tr>
<td>More than one dream scene</td>
<td>Then try to recapture what was happening before, or possibly after the first scene recalled and rehearse each of these other scenes. Eventually “relive” all the remembered scenes of the dream, following the order of succession of the dream events, which is usually very clearly memorized.</td>
</tr>
<tr>
<td>Oral recording</td>
<td>Only after that recapitulation, switch the light on, switch the recorder on and record an oral description of the dream. You know that questions will be asked to you about the setting of the dream, therefore pay attention to its features (or to the fact that it was not clearly represented in the dream).</td>
</tr>
<tr>
<td>Written report</td>
<td>Later on in the morning, write down the transcription of your oral report, as close as possible to its oral version.</td>
</tr>
<tr>
<td>Questionnaire on dream setting</td>
<td>Fill in the given questionnaire for each dream scene (see Table 2).</td>
</tr>
</tbody>
</table>

These instructions describe an ideal case, when the dreamer takes the time to focus on the dream activity and closely report a dream. Certainly there are also spontaneous or salient dream recalls, where nevertheless some of these steps might help to get a more accurate report. Salience refers in this context to the personal importance, but also to the visual richness of a dream (Kerr 1993).

In order to specifically focus the attention of the awaken dreamer on the dream location and on the other psychologically relevant aspects for each dream scene, we propose the following questionnaire (Table 2), to be completed after the dream log.
Table 2. Questionnaire for a dream scene.

**Questionnaire for a dream scene**

Please write your thoughts about the remembered dream scene, including elements from the real life which you think might be connected to it. Then answer the following questions, if they apply. It is always possible to answer “I don’t know”, “I don’t remember”, or “It was not clear in the dream”.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the dream location: visualized / known without visualization / completely indeterminate?</td>
<td></td>
</tr>
<tr>
<td>Is the location identifiable or not?</td>
<td></td>
</tr>
<tr>
<td>Is the location familiar or not?</td>
<td></td>
</tr>
<tr>
<td>Is the geographical situation specified? If yes, what is it?</td>
<td></td>
</tr>
<tr>
<td>If visualized: What was clearly distinct / vague / fuzzy in the setting?</td>
<td></td>
</tr>
<tr>
<td>If clearly visualized: is there a condensation of features of two or more places? If yes, which ones?</td>
<td></td>
</tr>
<tr>
<td>Does the location correspond: to your current waking location / to a past location / to a visited location / to a place where a relative or friend lives?</td>
<td></td>
</tr>
<tr>
<td>Which of the following categories does it enter: built up / countryside / hills / mountains / seaside / exotic / fantasy / science fiction?</td>
<td></td>
</tr>
<tr>
<td>Does it enter a subcategory? (e.g. street, in front of a shop; meadow, path; etc)</td>
<td></td>
</tr>
<tr>
<td>Could you orient yourself easy in the setting / did you have difficulties with the spatial orientation?</td>
<td></td>
</tr>
<tr>
<td>What memories (if any) come to your mind about such a location? Describe the memory and specify your ideas or emotions linked to that memory.</td>
<td></td>
</tr>
<tr>
<td>If the location is indeterminate, can you think of elements that could nevertheless materialize the dream setting? (e.g., spoken language, signposts, infrastructure, natural phenomena)</td>
<td></td>
</tr>
<tr>
<td>Please check that your dream report describes everything you visualized or you had the feeling to know during the dream experience about the setting of the dream scene. You must not be surprised if you were aware of only a few aspects of the setting.</td>
<td></td>
</tr>
<tr>
<td>Was the dream scene emotionally neutral / pleasant / unpleasant? (Specify the emotion)</td>
<td></td>
</tr>
<tr>
<td>Were you trying to achieve / avoid something in the dream?</td>
<td></td>
</tr>
<tr>
<td>Did you have the feeling to succeed / fail in something? If yes, in what?</td>
<td></td>
</tr>
<tr>
<td>What senses did you use in the dream: vision / hearing / touch / smell?</td>
<td></td>
</tr>
<tr>
<td>Feel free to add comments, if you wish.</td>
<td></td>
</tr>
</tbody>
</table>

There are certainly other important dream elements (see also Table 3), which are not covered by this questionnaire. This has two reasons: first, the questionnaire may not be too long, otherwise people might feel inhibited to fill it; second, important elements in a dream scene (e.g. the social encounters) are usually most prominent in the dream report itself (as a narration) as well as in the awake thoughts about the dream (see the first question in Table 2).
5.2. Data Modeling

The dream reports are in form of narrated natural language. To start mapping the dream content, we first need to get the necessary information from the input data. Our approach is data modeling. Therefore, similar to Reuschel, Piatti and Hurni (2013, 148), we create different classes of space types for the general location information in dreams, such as geographically related or not, condensed or mixed places, etc.

Space is just one dream element and other elements such as social interactions, goal pursuit, emotions or time flow, deserve as well closer attention. Table 3 summarizes important criteria along with guiding questions for their demarcation in dreams.

Table 3. Criteria proposed for dream visualization and considerations made toward their modeling into parameters

<table>
<thead>
<tr>
<th>Proposed criteria for dream visualization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dream place / space / location</strong></td>
</tr>
<tr>
<td>Is the setting of the dream scene identifiable? How clear is the location represented? Is it a complete or a partial view of the setting? Is it familiar to the dreamer? What type of landscape does it represent? Is there a condensation of two or more places? A comparison to a “known” place? How significant is the setting in the dream scene?</td>
</tr>
<tr>
<td><strong>Social Interactions</strong></td>
</tr>
<tr>
<td>Are there any social interactions in the dream scene? Which is the nature of the interactions? Are they reciprocal? How do the social interactions change across the dream? Are these positive, neutral, or negative?</td>
</tr>
<tr>
<td><strong>Actors</strong></td>
</tr>
<tr>
<td>Are there any other actors in the dream scene? Are they familiar to the dreamer? Masculine or feminine? Are they dominant, caring, helpful? Do they appear continuous in the dream scene? Where are they in the real life (if applicable)?</td>
</tr>
<tr>
<td><strong>Goals</strong></td>
</tr>
<tr>
<td>Does the dream scene contain any goal directed behavior? Is it a step done towards or away from goal achievement? Are there any obstacles encountered? How does the dreamer feel about the goal? Does the perceived goal change throughout the dream?</td>
</tr>
<tr>
<td><strong>Perceiving of self</strong></td>
</tr>
<tr>
<td>Takes the dreamer active or passive part to the dream? What is the emotional state of the dreamer? Where is the dreamer in the real life? With which senses does the dreamer perceive the dream?</td>
</tr>
<tr>
<td><strong>Emotions</strong></td>
</tr>
<tr>
<td>Is the overall emotion related to the dream scene positive or negative? How strong is this feeling?</td>
</tr>
<tr>
<td><strong>Time flow</strong></td>
</tr>
<tr>
<td>Does the time flow continuously? What is the time frame of the dream scene? And of the whole dream? How do the dream scenes flow?</td>
</tr>
</tbody>
</table>

Based on these questions we prepare a detailed modeling schema of the dream elements into parameters, by adapting the literary space model as proposed by Reuschel et. al (2013) and the coding system developed by Hall and Van de Castle for the quantitative analysis of dreams (Hall and Van de Castle 1966; Domhoff 1996).

---

2 E.g. „It was like in the Lord of the Rings”
These are supplemented with specific schemas for additional elements and features, as needed. The resulting parameters are saved for each dream and dream scene into the project’s database in order to be retrieved for visualization. If a dream element cannot be automatically modeled based on the dream report, questionnaire and modeling schema, then, in the ideal case of targeted, interactive dream acquisition, the dreamer might be requested to select a category or concrete specify or add an element.

5.3. Visualization

Dream Cartography proposes different visualization methods to be chosen from and combined into a dream illustration. For special dream space we produce location maps with special differentiation and creation method for mixed, condensed and distorted places. For vague or fuzzy locations we adapt the existing methods for mapping of uncertain geodata. For missing geographical location we propose a tentative visualization of relative positions between physical dream elements, but also of the relative position between dream characters and physical elements (e.g. near the door, in a corner).

A special case of settings in dreams is condensation of two or more places. When features of two or more different, familiar objects are combined to create a new object in dream, we speak of creative condensation (Blechner 2013, 62). The condensation of places, or, for that matter, of persons in dream is a known phenomenon, described already by Freud (1900). In the nineteenth century Galton is known to have merged two photographs together to form a composite image. This process, achieved with computers, is nowadays called “morphing” and we choose this technique to represent the condensation of places in dream. Morphing is mostly used in film industry, but also in criminal police for faces of suspects. Takeuchi and Perlin illustrate the application of morphing to city design (2012). There are also other techniques such as puzzle-like collage (Goferman, Tal, and Zelnik-Manor 2010) of maps or the simple depiction of puzzle tiles on the unchanged world map, which are currently under consideration for condensed or mixed places. Although morphing is seen nowadays mostly as a dynamic process of smoothly transforming one image into another one, we emphasize here the smooth transition made between map parts as different from a map collage. The output of morphing in this case is a map with harmoniously combined elements, as it would represent a continuous region and which is congruous with the transitions experienced in dreams. In contrast, in a puzzle-like collage the individuality of the compositing elements of the collection is not only clearly visible but also, sometimes, even purposely highlighted.

For the non-spatial dream content we propose alternative visualization models such as diagram-like representations of time flow and character occurrence and graph- or network-like representation of the social interactions, the latest inspired for example from Moretti’s plot analysis (2013). For the coding of dream elements’ values (e.g. types of social interactions with the properties of the appearing characters, the valence/emotions, the existing of goal directed behaviors, the attitude of the
dreamer) we combine established visual variables: color hue, color value, shape, size, orientation, texture (Bertin 1983), color saturation (MacEachren 1994) and transparency (Wilkinson 1999); use topology, as a link to geography, and specifically created symbols in maps and diagrams or networks.

Part of the visualization concept is the user participation, therefore the display of a first rough visualization draft on the screen as soon as possible, followed by an interactive editing phase: enter of additional information or adjusting of the visual elements. Participants may thus try alternative offered visualizations to get one that “feels” right for them, and so participate to the map composition for obtaining a more detailed and meaningful dream map. A good reason for this participation is to avoid beforehand interpretation of the dream in the dream map. Finally, brings a richer understanding of the dream itself because of the possibility to choose elements from a superordinate category (Montangero 2009) for depicting dream places, actions or objects. In this way Dream Cartography lets participants visually reformulate their dreams. We illustrate hereafter as proof-of-concept some of our proposed visualization elements for dream space, respective for social encounters in dream.

6. Visualization Examples

For the examples below we refer to openly available dream reports, in particular to the dream series published in German by a philosophical psychologist and university professor in book form (von Uslar 2003). Von Uslar wrote down and documented more than 6000 of his own dreams between 1949 and 2001. Two examples are given, one to illustrate the possibilities of a dream setting and one to show social encounters in a dream.

6.1. Dream Space

Here a fragment of a dream report, written by Von Uslar in 1999 in Zurich (translation from German by C.M. Iosifescu Enescu):

*I lived in a university town, which bore combined features of Göttingen and Zurich. From Göttingen it had the old town, but from Zurich the buildings of ETH and the University, which lie above the city. In addition, both parties had long been separated by the Iron Curtain between East and West. I had already lived for decades down in the old town, which resembled Göttingen, and now I was again, for some reason, heading up to the ETH.*

Here, the dreamer shapes the setting from the beginning of the dream report and this turns out to be also the most significant element of the studied dream scene. With respect to the dream elements and their characteristics stated in Table 3, we understand the dream location to be an area of walking distance, part of a middle-sized city, formed of components from of two real cities, therefore a condensation of places occurred (see section 5.3).
Both original cities are familiar to the dreamer. Figure 1 and Figure 3 propose visualization elements for the dream setting: maps created by morphing / combination of elements from the two cities in the aerial view, respective at the city plan level. For their creation, we made use of the textual information from the dream report and the world knowledge, respective the actual location of the old city in Göttingen and of the universities buildings in Zurich.
Adding available background information about the dreamer and his written awake thoughts connected to the dream, we learn that the person studied in Göttingen (almost 50 years previous to the dream) and in the last 30 years was working (teaching) at the University of Zurich. Together with the mention of time in the dream report, “for decades”, this signalizes another prominent element of this dream: the time flow. Figure 2 shows the living locations of the dreamer in his real life, as they succeeded by time.

![Figure 2 Dreamer's living locations in time; in red the “Iron Curtain”, which separated East from the West Germany before 1990; Data: Google Maps & scribblemaps.com](image)

The dreamer spent his youth years in a town from East-Germany (Schwerin), which was separated from the West-Germany by the “Iron Curtain”, mentioned also in the dream report. Thereby the city of Schwerin is also, as the dreamer himself writes down, part of the “background” setting. We visualize the third town in the city plan (Figure 3a), by using a red transparent mask over the topographically higher part (see also Figure 3b) of the new city (Zurich part) in red, constant with the meaning of the red color in Figure 2. Also in red we draw the delimitation line between the parts of the two cities, with a spatial interruption and a path where the dreamer could have walked through in his dream.
Figure 3 City plan resulted from the combination of the old city Göttingen (upper left) with Zurich universities (bottom right) with components delimited from each other with a red boundary line (a) and with elevation information (b); Original data sources: city plans: OpenStreetMap contributors; elevation: Nasa SRTM

Figure 3b uses a shaded relief for conveying the height information, which is addressed in the dream. The shaded relief was generated from the digital elevation model obtained by combining the elevation models of the two cities.

The next example (Figure 4) shows another feasible visualization for a dream setting, which uses both an absolute position and relative positions. This is a fragment of a dream report, written by Von Uslar in 2001 in Zurich (translation from German by C.M. Iosifescu Enescu):

---

2 http://www2.jpl.nasa.gov/srtm/, accessed on 11.11.2014
I lived in a house that was right on the edge of a rocky slope, which went hundreds of meters into the depth just in front of the house. Below, directly at the foot of the cliff, stood the Bellevue Palace in Potsdam from which one could see directly on to the rock wall. [...]
Along to the dream, Von Uslar writes his thoughts at wakeup and there we learn that he mistakenly calls in his dream the palace in Potsdam as Belvedere instead of Sanssouci, because of its “beautiful view” (which is the meaning of Belvedere in Italian) to the stone wall. Moreover, he references a Magritte painting, which represents a stone house on a floating cliff (which we found to be “The Castle of the Pyrenees” by René Magritte). These expressive visual dream elements ask for a visual dream depiction. On that account, we grab keywords from the dreamer’s text, such as: stone house, cliff, Magritte painting, Palace Sanssouci, and we proceed to an image search over the Internet. There are nowadays many publicly available picture libraries (e.g. Flickr, social media), which can be automatically searched for a keyword and deliver usable pictures on any subject. An algorithm for graphical salience, for example, could make a first selection of some pictures, which are to be further presented to the user or randomly chosen from and put together in a collage. The collage, which finally represents the dream scene, must, of course, respect the given relative positions (“on the edge of”, “below”, “at the foot of”) of the keyword elements.

The beauty of this dream is that it not only contains strong keywords and relative positions, but also an absolute position, a geographical place (Potsdam, Germany). The combination of the previously made collage with a perspective view of the map, including artistic deformation (performed for this example with the Terrain Benders) empowers the dream scene with a location factor and a further visual element, in this case resulting in a new, fascinating landscape composition.

6.2. Social Encounters

Based on another dream fragment from Von Uslar (translation from German by C.M. Iosifescu Enescu) we illustrate one of our endeavors toward the visualization of social interactions in a dream:

[...] There I come together and talk with two boys, one of which I find very pleasant. [...] I ask him how can I reach “Grossen Moor” street and if a Mr. von Hartwig lives there. [...] I‘m asking about other acquaintances of my father as well, because I don‘t know where I could spend the night. [...] He sees it as a matter of course that I will spend the night at his place [...] and before that he would have to ask his foster father.
The dreamer encounters two persons in this dream scene and with one of them he develops a conversation. A continuous, thicker line with arrowheads on both sides symbolizes this relationship (Figure 5). Other persons are just mentioned in the conversation and they appear connected with interrupted line to the present / other mentioned persons.

Color values of the profiles symbolize emotions or attitudes of the dreamer towards the other persons: we chose green for sympathy and yellow for the father as relative. No recognizable attitude we coded as grey. The color saturation signifies in this example the participation of the persons to the dream scene. The network nodes that contain the characters may vary on the visual variable shape. Circles were chosen here (Figure 5) for the overall friendliness of the dream scene and other shapes (e.g. convex or concave) could stand for other emotional load.

The topological arrangement of the network is also an information carrier, relative edge length signifying the perceived relation closeness between dream actors, with or without actual interaction (edge materialization). The dreamer stands in the center of the network and the appearance of the persons in the dream scene is coded basically clock-wise, with nodes pulled out of this order when the drawing of connection-edges requires it.

We sketched human profiles (Figure 6 shows the masculine profiles) for different ages, considering the change in physiognomy with the age and we use these for the representation of persons in the social encounters network. If the age of a person plays a role in the dream scene, these profiles may be used accordingly (e.g. for “boys” in the Figure 5).
Several such series along with feminine profiles and indefinite gender profiles complete our collection and present a choice for the visualization of the actors in the social interactions network in dreams. The alternative is to use real pictures of the dreamed persons and cover these with semi-transparent color masks, but this depends on the willingness of the participants to upload pictures and requires pictures with a neutral face expression, for not intervening with the overall dream emotion (e.g. a picture with sad face expression into a happy dream scene).

We mention that other diagram and network styles are under consideration for the visualization of the social interactions network of a dream, and separate visualization propositions will be made for character occurrence in dream series.

7. Conclusion and Future Work

Dream Cartography is part of the humanized geography movement, along with the Literary Geography and other mapping systems, where the human being is explicitly taken into account and where experiences, emotions, and individual preferences or interests make a difference in the resulting map. In Dream Cartography we propose a visual “reformulation” of dreams based on dream reports, additional thoughts about the dream and common sources. In this paper we address in particular the data acquisition issue, stressing that there are ways to improve the quality of the dream reports, for example, by following instructions that guide the process of dream logging. Moreover, valuable information may be gathered through additional questionnaires.

Regarding the visualization elements, a key concept is the interaction of the dreamer or of the psychologist with the cartographic system. Therefore, the final step of data modelling, as well as the different map elements, may be refined by the users themselves, with the system proposing different visualization methods and map compositions and the participant choosing in an interactive mode the best-suited map result. This takes place online, on a specially prepared Web platform. Special effects such as themes (e.g., a treasure map or child’s sketch) applied to location maps and to the other visualization elements can increase the visual appeal of the dream map.

The vast complexity of the dream worlds suggests the need for a variety of visualization methods and thus innovative requirements for Dream Cartography, which we are looking forward to addressing in our future work.
8. Acknowledgments

This paper is part of the project “Dream Cartography - Mapping Dream Space and Dream Content into an Interactive Web Platform for Exploratory Analysis of Dreams” and supported by the Swiss National Foundation, grant number 205121_157087/1.

9. Author Information

Cristina M. Iosifescu Enescu is a PhD candidate at the Institute of Cartography and Geoinformation, ETH Zurich. She graduated with a Diploma in Geodesy at the Technical University of Civil Engineering Bucharest in 2003 and with a BSc in Psychology at the University of Zurich in 2011. Her research interests focus on Dream Cartography, graphical user interfaces for Web Cartography and the Cognitive Theory of Dreams.

Jacques Montangero is an honorary professor at the University of Geneva. He earned his PhD in Psychology at the University of Geneva in 1974 and since 1996 holds the title of doctor honoris causa from the University of Coimbra. His current research interests focus on the cognitive analysis of dreams as well as on the psychotherapy for anxiety and depression. He conducts dream analysis with the DMR (Description, Memory sources and Reformulation) method, which has been elaborated at his laboratory for the study of dreams at the University of Geneva for therapeutic purposes and development of creativity. He is actively involved in the dream research and published numerous books and articles on this subject.

Lorenz Hurni is a professor of Cartography at the Institute of Cartography and Geoinformation, ETH Zurich, since November 1996. He graduated in Geodesy at ETH Zurich in 1988 and completed his PhD in Cartography at ETH Zurich in 1995. He is managing editor-in-chief of the "Atlas of Switzerland", the Swiss national atlas. His main research areas include cartographic data models, tools for the production of printed and multimedia maps, as well as interactive, multidimensional multimedia map representations. He is a member of numerous national and international scientific and professional commissions.

10. References


Freud, Sigmund. 1900. *Die Traumdeutung*.


C.M. Iosifescu Enescu et al. 2015, AOM

———. 2012b. “Cognitive Approach to Dreaming.” In Encyclopedia of Sleep and Dreams, edited by Deirdre Barrett and Patrick McNamara Ph.D. Santa Barbara, California: ABC-CLIO.


