Investigating Visual Languages for Argument Mapping

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ABSTRACT
In this paper, we suggest that one of the main challenges facing tools for mapping and visualizing argument structures is the usability and readability of the visualizations themselves. Motivated by this challenge, this paper argues for more work into designing visual languages for argument mapping, with suitable cues for helping the user to read and understand arguments, in much the same way that natural language has evolved linguistic cues to help readers understand narrative structure and make sense of a piece of text. The paper then presents a particular project that provides an experimental setting for investigating suitable visual languages for argument mapping. The project aims to facilitate online deliberation, which involves helping users to understand and reflect on where their considered opinions lie within a deliberation-narrative space.

Categories and Subject Descriptors
H.5.4 [**Information Interfaces and Presentation**]: Hypertext/Hypermedia – *navigation, theory, user issues.*

General Terms
Design, Human Factors, Languages, Theory, Legal Aspects, Verification.

Keywords
Argument visualization, spatial hypertext, cinematic hypertext, cognitive coherence relations

1. INTRODUCTION
As [1] reminds us, reading argumentative structures, whether in text or in graphical form has always been a difficult skill to acquire. This is because making sense of the argumentative structure requires both having a sense of the detail as well as having a sense of the whole (particularly how one detailed area relates to another detailed area).

But whereas natural-language text has evolved many cue words (e.g. "however" and "because") that signal the semantic connections between elements of a single argument or between multiple arguments, no similarly advanced evolution has occurred in the visual languages used to depict argumentation.

Indeed, generally speaking, most computer-supported argument visualization (CSAV) work has not adequately explored how the different elements of a visual language can represent the different elements of argumentation. Current tools tend to use a limited selection of visual features such as basic color textures and basic shapes.

Thus, we argue here that, as a priority, CSAV research needs to more thoroughly investigate the appropriate cues and features in a visual language for depicting argumentation. In this regard, our current research will take as a starting point the contributions of [2] who investigated the use of visual languages for rendering discourse relations in hypertext. Using this and other related work, we will attempt to derive a set of visual principles that cover what is needed to visually depict argumentation. This research will be conducted within the setting of a particular research project, which we describe briefly at the end of the paper. The next section describes our preliminary investigation in this area.

2. INVESTIGATING SPATIAL AND CINEMATIC HYPERTEXT

2.1 Spatial Montage for Complex Discourse Relations
As stated in the previous section, it is our contention that current CSAV tools tend to use a limited selection of visual features for depicting elements of argumentation. In particular, it is our view that these tools do not adequately utilize the spatial aspects of visualization (i.e. the meaning and significance of positioning one graphical element near or far from another element). This lack of emphasis on the spatial seems paradoxical since most CSAV work is given the umbrella term of "argument mapping" – thereby making an implicit link with real cartography but then subsequently ignoring cartography's emphasis on spatial features.

Most CSAV tools tend to fall into the "link mapping" category of hypertext[1]. According to [3], link mapping provides a spatialized overview of linked networks, most often in the form of boxes linked by arrows. The author distinguishes this kind of hypertext from spatial hypertext, which he notes "also constructs visual displays, but instead of showing link structures, it relies on our ability to assign meaning to spatial positions and relations."

Furthermore, argument visualizations as currently performed still privilege the "single-step link pattern", even though the link mapping visualizations sprawl over a large space. That is, most argument visualizations are depicted so that reading from one node to another involves just a single, linear rhetorical move. Thus, current argument visualization methods have not adequately evolved to represent more complex, multi=step link patterns where complex rhetorical moves can extend over more than a single step. Investigations of such complex, multi-step link patterns can be seen in [4], where the author identifies patterns such as cycles, counterpoints, mirror world, tangle, sieve, montage, neighborhood, split/join, tour, missing link, etc.)

[1] Kolb [3] distinguishes four kinds of hypertext: page-and-link, stretchtext, link mapping, and spatial hypertext. He notes that a hypertext tool may include more than one of these kinds.

According to [5] "On the display screen, blank space opens a field of external relations for where-is and next-to and over-there and near-here relations among items that may represent all sorts of complex inner relations…" between elements of an argument. The author gives examples of well-known spatial hypertext systems such as the Visual Knowledge Browser and Tinderbox that make spatial manipulation and grouping the central action that the user can perform. Kolb [1] suggests that graphic manipulation of multiple spatially arranged text windows – what he refers to as a "spatial montage" – could enhance the presentation of argument on the Web. For him, spatial montage opens up a further dimension in which complex discourse relations can be expressed. This is one of the claims that we would like to examine within our research project.

2.2 Cinematic Hypertext and a Coherence-based Visual Language for Argument Mapping

Mancini [2] defines cinematic hypertext as "a distinct graphically enriched and animated form of hypertext that finds itself at the intersection between spatial hypertext, semantic hypertext, and page-based hypertext." She proposes that "discourse relations between hypertext nodes could be expressed following the same principles according to which discourse relations between cinematic shots are signalled through the consistent and concurrent use of visual features."

She then goes on to propose that cinematic hypertext could be useful in helping users to learn about a debate, specifically the relations between the different elements of a debate (claims, counter-claims, evidence, etc.). Mancini suggests that 'cinematic' hypertext could be used to present the debate to the users in order to help them understand this debate structure.

The novelty in Mancini's work consists of her application of text coherence and discourse comprehension[2] theory to the design of her cinematic hypertext application. In particular, she applies the theory of Cognitive Coherence Relations (CCR) [6], which postulates a set of primitive, cognitively grounded relation-parameters that account for how readers make sense of a discourse by making connections between the units of information in the discourse. These CCR parameters are used as "regulating principles for the consistent and congruent use of graphic features to connote the role of nodes with respect to one another and to allow the emerging of visual meta-discourse in hypertext." [2]. Thus, based on parallels existing between textual and visual processing, Mancini designs a prototype visual language for rendering cinematic hypertext links as discourse relations.

Taking Mancini's contributions as a starting point, we intend to investigate ways of extending the design of the basic graphical elements used to express discourse relations. One simple extension, for example, might involve extending the palette of colors used to go beyond the simple grey-scale used in Mancini's initial study.

[2] Discourse comprehension research is concerned with the process by which readers are able to construct a *coherent* mental representation of the information conveyed by a given text. Such a coherent mental representation is constructed when the reader establishes meaningful connections between the different units of information in the discourse.

3. EXPERIMENTAL SETTING

The setting for conducting this research will be within the EU-funded project IMPACT[3]. The IMPACT project is researching and developing a suite of tools for facilitating online, public deliberation of policies being proposed by governmental or non-governmental organizations. Our work within IMPACT involves, more specifically, developing an Argument Analysis, Tracking, and Visualization tool (AVT) as part of the larger toolbox.

The rationale for the AVT is grounded firstly in current e-participation research priorities, which seek technological support for improvements in the efficiency, inclusiveness, openness and accountability of public services and democratic processes. Specifically, the AVT is intended to support the work of relevant actors by enabling them to navigate through arguments contained in relevant consultation and policy documents. To adequately achieve this goal, the AVT will be based on the state-of-the-art methods and tools in the field of computer-supported argument visualization (CSAV).

Thus, our work aims to be at the intersection of CSAV and e-participation research, which means that in addition to developing the AVT tool and exploring how best to improve the readability of very large visualizations of arguments (often referred to as 'argument maps'), we will investigate the mediating role that such large, Web-based argument maps can play in e-participation scenarios.

One of our early design decisions was to reuse an existing CSAV platform in order to benefit from many of the advances made within that field. After a survey of the state of the art, we decided to reuse the Cohere tool[4] [7] as the platform on which to build the AVT in the IMPACT project.

Cohere is an open source, Web2.0 tool for argument analysis and argument visualization. We have decided to use Cohere as a platform for the AVT because it already supports a number of features that we believe the AVT should provide. These features include enabling users to create Web-based argument maps; to add, delete, and edit nodes and relations in an argument map; and to browse and zoom argument maps, making use of hyperlinks embedded in nodes to access further information (e.g. the original source data from which the node is derived).

Cohere also builds on existing work in developing the ClaiMaker tool [8]. The core data model of ClaiMaker has been carried through to Cohere and the visualizations are versions of those first prototyped in ClaiMaker. In this way, Cohere can trace intellectual lineage to work on incorporating CCR into the ClaiMaker.

Furthermore, as an open source tool it can be extended to include the new features as envisaged by the specific IMPACT project usage scenarios. For example, based on what is envisaged in the project, we will extend Cohere to Improve the capability to manipulate the layout of argument maps, particularly through the use of sophisticated layout algorithms, and to improve the browsing of argument maps at different levels of granularity.

[3] IMPACT stands for **I**ntegrated **M**ethod for **P**olicy making using **A**rgument modelling and **C**omputer assisted **T**ext analysis: http://www.policy-impact.eu

[4] http://cohere.open.ac.uk/

4. CONCLUSION

This paper highlighted one of the main challenges facing tools for mapping and visualizing argument structures, namely the usability and readability of the visualizations themselves. The paper then motivated the following research question: *How can we fill the gap in CSAV research dealing with deriving a visual language for argument mapping?* This research question will guide our future work in building a Web-based argument-mapping tool as part of an EU-funded research project aimed at facilitating online deliberation. As well as developing such a tool, the output that we will generate to address this research question will be set of visual principles that describe the essential visual cues and features that are needed to visually depict argumentation to better support users in understanding and reflecting on the opinions that make up a particular deliberation-narrative space..

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