Creative problem-solving in digital space using visual analytics: Synopsis

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Introduction

The field of interactive visual analytics (IVA) refers to approaches and technologies that facilitate visual data exploration and take advantage of significant human capabilities in visual processing and pattern recognition.

Smart and ever-connected electronic devices generate massive amounts of data. This ‘big data’ includes text, images, video, web traffic, tweets, sensor data and log files from sensors, smart devices and social collaboration technologies (Schroeck, Shockley, Smart, Romero-Morales, & Tufano, 2012).

While transactional business data is well understood and serviced by current data analysis techniques, this is not always true for big data, where hidden patterns, relationships and knowledge that are difficult to find (Bollier, 2010) become key concerns.

Although IVA involves complex analysis it also requires creativity and novelty. This paper developed a framework (Figure 1) for understanding and explaining digital creativity in IVA. This was achieved via a synthesis of existing literature in creativity, data analysis, visualisation and interactivity, and through analysis of existing IVA software, as well as our own development experience.

Background to the framework

The first step in developing the framework was to synthesise literature relating to IVA’s objectives. The annotated outward pointing arrows in Figure 1 show that IVA has a number of objectives, such as experiencing data, developing understanding, creating knowledge, solving problems, making decisions and communicating insights. We then explored and blended several well-known models of creativity to understand and explain how creativity is expressed and used to achieve these IVA objectives. The models analysed were drawn from the literature on creative processes (Shneiderman, 2000), innovative products (Amabile, 1983) and domain specific and general creativity (Baer & Kaufman, 2005). We also considered intrasubjectivity (e.g. Perry-Smith & Shalley, 2003) and intersubjectivity (Drazin, Glynn, & Kazanjian, 1999) as important for understanding creativity in IVA.

Creativity can be seen as a process that involves exploration and transformation of conceptual spaces in individual minds (Boden, 1991). Whereas Shneiderman (2000) describes three views of the creative process, the structuralist view appears most relevant to IVA since it applies a more systematic approach to exploring and transforming conceptual spaces. Structuralist process models describe typical stages of the creativity cycle. For our framework, we adapted Couger’s (1996) structuralist approach to articulate the following cycle: setting or refining the analytic problem; compiling and selecting information from multiple sources of structured and unstructured data; generating and evaluating ideas and insights; planning and executing actions; and observation and reflection which may lead to further iterations of the cycle. These cycle stages circle the outer edge in Figure 1.

Creativity can also be viewed from individual and social standpoints. However, every individual exists in a social context and every social context involves individuals, so these standpoints are necessarily intertwined.
The social perspective can be understood as a form of collaborative creativity. Analysts engage through interactive media to share ideas and actions (see Figure 1). Through the analytic process, they work together to explore and create meaning from data and visualisations. This activity occurs within the envelope of a specific socio-organisational context (Simonton, 2000). This context not only defines the audience for insights gained from analytic processes, but creates an environment which may either nurture or hamper teamwork and collaborative creativity (Simonton, 2000).

In IVA, participants in the creative process can adopt analytic roles across three interrelated domains of human experience: data, problems and a mediating general domain. This requires intrasubjective understanding in order to acquire personal knowledge (Susswein & Racine, 2008), as well as intersubjective understanding (Sampaio & Simão, 2013) that develops shared meaning (centre of Figure 1).

In exercising digital creativity in IVA, analysts develop intrasubjective understanding by mentally manipulating and examining data to uncover hidden patterns and relationships. IVA analysts routinely use innate abilities of creativity, intuition, perception, learning, reasoning and engagement (the inner circle of six segments in Figure 1). And a unique feature of IVA creativity is the analyst’s interaction, and cognitive and emotional engagement, with visual media.

At the same time, a collective social experience, common culture and similar educational and work environments facilitate intersubjective understanding between data, domains and visual analysts. Intersubjective creativity is particularly evident in visual narratives and metaphors, since analysts must jettison the constraints of their knowledge domains, and simplify communicative content and processes, to develop such narratives.

Finally, IVA can also be assessed as a creative product, or range of creative products. For
example, reusable analytic processes or insights could be viewed as tangible creative tools. Creative products are also commonly evaluated in terms of novelty (one of the requirements for IVA) as well as value (Boden, 1991; Sternberg, 1999).

Conclusions

The framework developed in this paper explores and blends a number of models of individual, social and domain creativity in the context of IVA. However, compared to other forms of digital creativity, IVA relies on analytic models and involves the iterative generation and evaluation of digital media ideas, as well as planning, implementation and refinement of action.

Digital creativity is expanding into new and unexplored areas, of which IVA is one such inquiry. To this end, the framework developed here makes an important contribution by providing a theoretical roadmap to digital creativity in the context of interactive visualisation and analysis. The framework suggests how digital creativity can evolve in IVA and how elements characteristic of IVA in turn create opportunities for digital creativity. Lastly, the framework can be used to prompt empirical questions and inspire further research, of which the full paper offers some suggestions.

References