Storytelling as playful exploration of biological image data: reviewing a candidate interaction paradigm

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STORYTELLING AS PLAYFUL EXPLORATION OF BIOLOGICAL IMAGE DATA: REVIEWING A CANDIDATE INTERACTION PARADIGM

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ABSTRACT

This paper investigates storytelling as a way to interact and engage with scientific image data. Arguing that scientific practice can benefit from a moment of openness and playfulness, we look for inspiring interaction paradigms along the lines of playfulness, exploration and creativity. Storytelling is such a candidate paradigm we review and scrutinize in this paper. More specifically, we provide an overview of interdisciplinary ideas and practices regarding storytelling with images and highlight noteworthy meeting points of stories and interaction design. Special attention is paid on how the field of HCI has approached, incorporated or facilitated the act of storytelling with images. A wide range of applications, from card games to mobile applications, are collected and discussed. Existing storytelling practices and traditions could inform the design of new artifacts for a story-based interaction with scientific images.

KEYWORDS

Stories, storytelling, scientific image data, playful interaction.

1. INTRODUCTION

What do stories, biological scientific practice and human computer interaction have in common? In this paper, we examine the applicability of storytelling as a way to interact and engage with scientific image data in the life sciences. Scientific practice is a particularly important human activity, both economically and socially, and a complex practice that can be supported by computerized systems at various stages and by various degrees. As such, it is a valid subject not to be neglected by the domain of human computer interaction. From the various tasks involved in scientific research, we focus on the needs of scientists as creative practitioners. More specifically, we contemplate on the opportunities to design systems or interactions that can stimulate creativity during research, in general, and during processing of biological image data, in particular. To that end, we set out to look for inspiring interaction paradigms along the lines of playfulness, exploration and creativity. Storytelling is such a candidate paradigm we review and scrutinize in this paper.

Biology is a science with a great deal of visual clues. Much of contemporary biological research is based on the production, inspection and analysis of image data as produced by various experiment designs and various imaging systems. Obviously, biological image data are used in scientific discourse and publication as persuasion and communication means to support and better demonstrate a finding. Nevertheless, the life cycle of a scientific image is much richer and far more dynamic. Consider as an example the ongoing role of images during research, when images as preliminary or intermediate findings are used to guide and refine research choices. Images as snapshots of ongoing research must be discussed and reflected upon for further decisions to be made. We believe that this process of managing one's research by incorporating image data can benefit from a more open-minded and exploratory attitude of the researcher. In search of new ideas, challenging questions or simply insightful observations, it is often useful to re-consider and re-interpret one's own data under the light of other data or under the light of new associations. It is also useful to be open to non-obvious and even unexpected associations. In other words, creative problem posing and creative problem solving may require a moment of openness, playfulness and exploration.

This paper examines storytelling as a potential strategy to support such a playful and exploratory interaction with image data in biological research. Eventually, we aim to design an artifact to engage the user/player in storytelling for the sake of playful exploration. We are particularly motivated by the role of associations, the possibility to re-view data by establishing associations and the role of imagination as a way to articulate potentially useful ideas, toy with possibilities and even create associations where there appears to be none. A story-based interaction with biological images may be a valid strategy to ignite similar processes: By creating opportunities for storytelling, we hope to create opportunities for a great deal of re-consideration, re-interpretation, imagination and filling-in of gaps to be at work. By confronting a user/player with the challenges of story composition, we hope to probe and elicit useful responses to image research material.

Stories and images may be strangers in the realm of science, but utilitarian usages of storytelling are found in a variety of domains. This paper provides an investigation of interdisciplinary ideas and practices regarding storytelling with images. While part of our own research on storytelling with scientific image data, this study highlights noteworthy meeting points of stories and interaction design. Relevant characteristics of stories and storytelling are further discussed in section 2. Section 3 reviews related work on storytelling with images as seen from an HCI perspective. In a way, our study summarizes, revisits and groups together a variety of practices and traditions often held apart; this synthesis would be of interest to HCI practitioners curious about storytelling, in general, and storytelling as part of playful design, in particular. Conclusion and future directions are provided in section 4.

2. BACKGROUND

This section summarizes relevant aspects and qualities of stories and storytelling as derived from a variety of disciplines. Such contributions motivate us to propose a story-based interaction with scientific image data.

2.1 Of Stories and Storytelling: a Few Definitions

First of all, what is a story? Defined casually, a story is an account of events; these events can be "either true or false" (Polkinghorne, 1988, chapter II). Everyone's got a story to tell, and it need not be one of a literary value. Stories and narratives can be treated as either synonym or distinct terms depending on whether a story is understood as distinct from its rendering (Abbott, 2007). We will use the term "story" and "narrative" interchangeably, with story being the account of a sequence of events rather than only the sequence of events accounted. This definition is closer to an everyday understanding of the term "story" but it still allows us to consult the extensive field of narratology, i.e. the study of narratives. However, here be dragons! The field of narratology is a fearsome one, perturbed by its own definition wars, including ones on the definition of narrative. An account of a sequence of events may not always demonstrate a satisfying degree of "narrativity"; a typical example given is the chronicle.

The focus of this work is on storytelling that includes and initiates from images. To be more accurate, it is about story-making rather than story-telling. For the remaining of this paper, the term "storytelling" will refer to the telling of a story that is actively generated by the storyteller, rather than the reciting of an existing story. Story-making need not be mediated by an artifact, but there exists a long tradition of "user-generated" stories, i.e. stories unfolded or produced by the user's interaction with a tool or platform. Numerous environments or strategies have been attributed a capacity to support or engage a reader or player into the production of narratives: Hypertext fiction, interactive storytelling and videogames, mainly adventure and role-playing games, are a few typical examples, all distinct in their mechanics and aesthetics and yet alike in their ascribed potentials to transform "traditional" narratives. From a cybertext theory (Aarseth 2007) perspective, user-generated stories will involve "non-trivial effort" and interaction with a mechanism/ algorithm operating on a set of building tokens. We are aware of this tradition of interactive and playable stories and acknowledge the impact of technologies and interactivity on the way stories/ narratives/ narrations emerge. Technically, the use of small units of information to be assembled by the user in a meaningful storyline is a theme we adhere to. However, we are less interested on the trails of the user as an output (cf. hypertext) or the choices of the player on particular forking or decision points (cf. interactive storytelling). In a way, our interest in connections (to be established) and gaps (to be filled-in) loosely corresponds with early

ideas on hypertext as an organizational mechanism with a capacity to inflict "order over chaos" via the establishment of links.

2.2 Why Stories?

There is a substantial tradition on storytelling as a means to understanding. Firstly, stories have been long acknowledged as carriers of information and as a means to transmit know-how, beliefs and values across generations. Their cultural significance aside, stories are powerful communication tools. This applies to the domain of science as well: As most science communicators would confirm, stories about famous scientists, significant scientific discoveries and even complex scientific phenomena are powerful and engaging educational aids. An extensive overview of the applicability of narratives for science education and science communication is provided by Avraamidou and Osborne (2009). Clearly, stories help transmit a message and make a speaker easier understood. But can a story make a speaker easier understood to the speaker herself? In other words, can the composition of a story contribute to understanding? Several practices would support the case as stories have been frequently used to either elicit or organize information. Consider as an example the use of narratives in social science research: Stories have been repeatedly used as the means for human subjects to articulate about their experiences. What is more, narrative inquiry as a methodology engages with stories as both the subject and the means of the inquiry. That is to say, stories are either the collected material to be analyzed or a medium for the researcher to make sense out of her own observations (Polkinghorne, 1988, chapter VII; Pinnegar and Daynes, 2007). In a similar fashion, storytelling has been applied for knowledge management in organizations, e.g. as a way to verbalize tacit knowledge about a task or about the organization (Hannabuss, 2000.; Rhodes and Brown, 2005) . Similar practices are to be found in the field of HCI, with storytelling being used as a tool for brainstorming or user-centered research (cf. section 3.2). In all of the above cases, storytelling is employed to stimulate and facilitate the articulation of useful information and knowledge that would otherwise remain implicit.

Storytelling seems to be a natural and comfortable way for humans to cope with information and complexity. The idea of a narrative way of thinking which qualifies as a distinct mode of reasoning was pioneered by Bruner (1986) and Polkinghorne (1988). The exact nature of narrative knowing and narrative reasoning as well as the exact relation of narrative reasoning to paradigmatic (or logico-scientific) mode of reasoning are discussions we will refrain from. However, we find it fascinating that the way we process stories requires a particular way of connectivity between parts. Firstly, it requires some connectivity: Parts of a story become meaningful because they contribute to a plot. To quote Polkinghorne (1988, chapter II), "human narrative ordering makes individual events comprehensible by identifying the whole to which they contribute". Secondly, the connectivity involved is of peculiar nature. The causal relation between parts is by far not necessary, but it is still sufficient. As Worth (2005) summarizes, "narrative lines of reasoning do not generally prove anything, but they do show how something might have come to be the case". In a way, what makes stories particularly attractive is exactly the need to devise or imagine explanations that impose coherence over discrete items.

3. STORYTELLING FROM AN HCI PERSPECTIVE

In this section, we examine how the field of HCI has approached, incorporated or facilitated the act of storytelling with images. Loosely speaking, we organize our examples under two areas of interest: 1) storytelling as play and 2) storytelling with utility. This distinction is only a means to organize our presented cases; a clear-cut distinction between these intents is cumbersome. By storytelling with utility, we refer to practices that apply storytelling as the means to an end such as to organize data, elicit information, share knowledge or stimulate inspiration.

While the act of storytelling is internal to all the activities and artifacts discussed, the means employed range from purely analogue, e.g. card-based storytelling, to entirely digital. Storytelling in the digital domain may refer to a variety of activities, from the authoring of multimedia narratives to interactive storytelling in gaming environments. Correspondingly, the extent of automation and computational support varies. Purely generative storytelling by computer is not part of this study. "Digital storytelling" tends to refer to storytelling for educational purposes as assisted by productivity software (Meadows, 2003; Robin, 2006), but

we use the term for any method that utilizes a digital tool or environment. Finally, it should be stressed that this study focuses on storytelling that includes and initiates from images; creative writing exercises, e.g. for reflection or education, will not be further discussed.

3.1 Playing With Stories: Games, Story Kits and More

Play and storytelling are not interchangeable notions (Nicolopoulou, 2005) but every child knows that making up stories is (part of the) fun. Given the significance of storytelling for the development of a child's literacy and the close relation between play and storytelling, the field of children computer interaction has shown proliferating interest on storytelling for play and learning. Children specific products are outside of the scope of this study but the overwhelming research on digital storytelling for children must be mentioned. Once again, digital storytelling understandings range from multimedia stories authoring, to playing with smart storytelling toys, to interactive storytelling. An overview of digital storytelling from an educational perspective is provided by Farmer (2007); for an HCI perspective, see the review by Garzotto et al. (2010). Finally, a useful summary of digital storytelling interfaces for children is provided by Göttel (2011). Although particular to a subset of HCI literature, i.e. Computer Supported Collaborative Learning, the themes of remote authoring, collocated authoring and enriched experience are indicative.

Constructing a story, usually in collaboration with other players, is a valid way for all ages to play as demonstrated by various games dedicated to storytelling. The relations between storytelling and gaming are many and perplexing but, for the purposes of this study, we consider straightforward storytelling games that are explicitly about composing stories. In particular, let us examine the gameplay of two storytelling games using imagery, namely "Once upon a time" and "Rory's Story cubes". "Once upon a time" (Atlas Games, 1993) is a popular storytelling card game based on the fairytale genre. Players are dealt storytelling cards, depicting common fairytale elements, and one "happy ever after" card each. The storyteller uses her cards to create a fairytale story, working her way toward her ending card. However, the storyteller may be interrupted by another player who then picks up the task of storytelling. The first player to finish her cards, concluding the story with her ending card is the winner. "Once upon a time" is a typical example of storytelling out of the combination of randomly distributed tokens (combinatory). Moreover, it employs formal elements (in this case, fairytale motifs) and some knowledge of narrative theory to aid the storyteller. On the other hand, "Rory's story cubes" (The Creativity Hub Ltd., 2007) is a purely combinatory storytelling game without any additional support for the player. The player rolls 9 icon-sided dice and creates a story with the pictograms tossed. Note that the "Rory's story cubes" game is also advertised by its designers as a creative exercise, an aid for inspiration and a creative problem solving tool.

The "Rory's story cubes" puzzle game has been recently ported into the digital domain as an application for the iPhone/iPad market. The smartphone platform is of particular interest to this study due to both the afforded interactions and the often toy-like nature of smartphone applications. Table 1 reviews a few storytelling applications available in the Apple App store in September 2011. Language learning applications for children, interactive books for children and scriptwriting productivity tools were not considered. Not all retrieved applications are clearly described as games, but many point out the qualities of storytelling as creative play. Overall, storytelling is discussed as either creative play or as a way to organize and share one's own photos. From an HCI perspective, storytelling for the organization of personal data is a particularly significant theme. As discussed in the coming subsection, the metaphor of storytelling has been indeed utilized in interfaces to personal photo collections for both sharing and retrieval. Lastly, storytelling augmented by geographic location information (cf. "Tagwhat") is a frequent subject of interest for mobile human computer interaction and pervasive computing.

Table 1. Storytelling apps for the iPhone/iPad platform as retrieved from the Apple App store (September 2011, URLs accessed: September 29, 2011). Two word-based storytelling apps ("Writer's hat" and "Thumbstruck") and one Korean-based storytelling app ("Story maker") were retrieved but not included in this table. Key: combinatory = based on combinations of randomly distributed (existing) image tokens, authoring = choose, order and edit image tokens

Name	Vendor's URL	They say...	Type	Image tokens	Story Annotation	Story output
Blurb	http://www.blurb.com/mobile	"a fun, fast, public or private, way to create stories featuring all your personal media"	authoring tool	own images and videos	text, audio clips	multimedia stories
Bokies	http://bokiestorybooks.com	"a bit of a book and a movie rolled together"	remixing tool	given video clips	audio narration	storybook
Fable scapes	http://www.streetsoft.eu/fablescapes-iphone-app	"The first application conceived especially for the purpose of creative storytelling"	authoring tool	pre-animated clip art on given story themes	-	-
King of Dragon Pass	http://a-sharp.com/kodp	"It blends interactive stories and resource management into an epic saga of conflict, magic, and community"	turn-based strategy game with emphasis on stories	game art	-	-
Rory's Story cubes	http://www.storycubes.com/products/iphone	"9 cubes, 54 images, Over 10 million combinations, Unlimited stories!"	combinatory storytelling game	pictograms	-	screen capture
SonicPics	http://www.sonicpics.com	"a very easy to use tool for turning your images into custom slideshow movies that you can share with your friends online!"	authoring tool	own images and videos	audio narration	video
Story shout	http://storyshout.co.uk	"A game that challenges you to invent stories against the clock. Fun, social and addictive"	combinatory storytelling game	pictograms	-	-
Storykit	http://en.childrenslibrary.org	"Rewrite 'The Three Little Pigs' with the wolf as the victim. Or, start with a blank book and write whatever story is on your minds"	authoring tool	own images, given book pages	drawings, text, audio clips	storybook
Storyrobe	http://www.storyrobe.com	"an exciting new digital storytelling application for the iPhone and iPod Touch"	authoring tool	own images and videos	audio narration	video
Storywheel	http://www.storywheelapp.com	"a cooperative story creation application... designed to work in conjunction with one of the most powerful computers in the world - The human mind"	combinatory storytelling game based on formal narrative structure	pre-aminated clip art on given story themes	audio clips	multimedia stories

Name	Vendor's URL	They say...	Type	Image tokens	Story Annotation	Story output
Tagwhat	http://www.tagwhat.com	"a mobile product that tells great stories about the places around you."	locative augmented reality	(use online wizard)	(use online wizard)	multimedia stories

3.2 Storytelling with a Utility: Stories as Methodology

As Gruen (2000) remarks, there are stories within interactive systems and there are stories about interactive systems. In this subsection, we examine the various ways HCI has appropriated storytelling for the design of interfaces, as either a design method or an interaction metaphor. General purpose productivity software for authoring multimedia stories will not be discussed. Rather, we investigate the introduction of stories in systems or processes that are not *per se* storytelling ones.

What makes storytelling an attractive design methodology? For one, its capacities to stimulate the imagination, ease communication and facilitate verbalization of ideas or knowledge. The field of interaction design has employed the practice of storytelling in various stages and in various ways, from producing user case scenarios to fostering collaboration (Erickson, 1996; Gruen et al., 2002). When it comes to collaborative brainstorming, storytelling and playing are often intertwined: Various design games, such as the ones discussed by Brandt and Messeter (2004), Johansson and Linde (2005) and Johansson (2006), are simple card games that require verbal articulation. On the other hand, with interaction design and HCI taking a true participatory approach, storytelling is also a tool to elicit and collect valuable information from the user. As such, it is exercised by the user rather than by the designer. Consider also the practice of HCI probes, initially proposed by Gaven and et. (1999), i.e. the use of physical artifacts as prompts to elicit and collect user responses that can further inform and inspire the design process. One of the qualities of HCI probes, among others, is their capacity to capture information that is often unreported or deem irrelevant by the user. Probes come in a variety of forms but photo-collages, diaries and postcards are frequently included in probe kits. Sometimes, storytelling is also employed as a means to discuss with the users the material they collected using the probes (Mattelmäki, 2006). The notion of probes as physical triggers and their potential to articulate often unreported information is particularly attractive. In a way, we imagine a storytelling artifact that functions in a similar probing fashion.

Next to providing a design methodology, storytelling also provides a compelling metaphor for the design of interfaces. Let us repeat here that we, humans, naturally use stories to organize our experience. This is particularly prominent in the way we interact with images: Storytelling based on photos is a very natural way of interacting with personal photos. Formal research by Chalfen (1987) on how people interact with printed photographs confirms that printed photos quickly turn us into storytellers. Frohlich et al. (2002) distinguish between storytelling with images and reminiscing talk with images, but do not dismiss the importance of storytelling as a means to co-present sharing. Systems for the management of personal digital photo collections have attempted to either include and facilitate storytelling or exploit the stories of the photos as a more intuitive organization of the collection. The widely cited work of Balanovic et al. (2000) aids the authoring and sharing of stories with digital photos in a fashion that resembles yet augments common interactions with printed photos. Other systems have explicitly included storytelling as a mechanism to annotate and organize material. Landry and Guzdial (2006) and Kuijk et al. (2010) employ story annotations as a means to improve image sharing, while Kuchinsky et al. (1999) and Ames and Manguy (2006) as a means to intuitive management and retrieval. The idea of data organization by narrative has been applied to generic documents as well. Gonçalves and Jorge (2008) propose organizing and querying personal documents by story elements such as time, place, purpose etc. In this case, the story about and around the document is exploited for annotation and retrieval. Finally, of particular relevance to the purposes of this study is the work of Kuchinsky et al. (2002): The authors propose a biological storytelling metaphor as a means to organize various data about biological entities (genes, proteins, etc). We endorse the propositions by Kuchinsky et al. (2002) on the relevance of storytelling for scientific reasoning and practice; their notion of synthesis as a necessary part of hypothesis formulation greatly corresponds to our notion of a synthesis via the establishment of associations. However, their work does not consider the particularities of image data and of image-based storytelling, which have been the focal point of our study.

4. CONCLUSION

This study examines and groups together various ideas and practices regarding storytelling with images. We have collected and discussed processes, methods and products with a storytelling component that can be of relevance to interface design, in general, and the design of playful and exploratory interfaces, in particular. All in all, this overview confirms significant parallels between the practice of storytelling, in one hand, and a playful and exploratory interaction with images, on the other. Our interest in a specific application domain, i.e. scientific practice and scientific creativity, allows us to revisit existing practices, such as storytelling for brainstorming, and examine them with a fresh mind, especially for their capacity to promote associations. What we repeatedly observe is that storytelling allows participants to make explicit, to make coherent, to play, to share, to organize; such observations strengthen our belief that storytelling with images is a paradigm worth-considering when a creative re-interpretation of images is desired. In addition, and in line with our interest in establishing non-obvious associations, we hope to have contributed some thought-provoking connections between subjects and domains not usually examined together. Seemingly distant and yet already valid applications of storytelling, e.g. by gamers, by children, by designers, can be valuable sources of inspiration when devising story-based interactions with images. In the end, we hope to have motivated our readers to consider the tradition of storytelling for new purposes and applications.

It is worth summarizing here a few common themes identified along the way. Generally speaking, storytelling with images is perceived as either creative play or as an articulation mechanism, regarding both new and existing knowledge, or as a means to impose structure. Used as an organization metaphor in interfaces, storytelling is generally utilized to either facilitate image sharing or to facilitate image retrieval. Similar themes are present also in the mobile platform market, where one finds both game-like and authoring-like storytelling applications. Overall, and as this review demonstrates, storytelling with images spans across a variety of applications, from analogue games to video games to story editors, and a variety of story construction methods, with or without a narrative theory backdrop and with or without generative capacities. These features mark a valid design space of potential storytelling artifacts. We are currently exploring a small part of this design space by conducting users studies with user biologists. Such studies will allow us to better conceive the nature of a story based-interaction with images and the form of an artifact to support storytelling for research. Certainly, the context of scientific practice imposes additional requirements: E.g. while storytelling with personal images is a natural response, storytelling with research images might be not. Eventually, a concrete artifact should allow us to better study storytelling as a mechanism towards a playful and exploratory interaction with scientific images.

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