Connecting the dots : playful interaction with scientific image data in repositories

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Chapter 6

Conclusion/Discussion

6.1 Overview

Congratulations! You made it to the last chapter. If you arrived here linearly, i.e. after having read all the previous chapters in their provided order, then the conclusion of this thesis will come as no surprise to you. I have discovered no law of nature; I was not looking for one at the first place. But I have learned plenty. Namely, I know to have:

- challenged, stretched, revised and revisited my own understandings and views on the core subjects of this thesis, i.e. play, science, creativity
- been many a times impressed by my users, their ideas and their capacity to find their own purpose and value in my ideas and artefacts; their input has been extraordinary useful, informative and enriching
- stumbled upon many a pitfalls, dead-ends, mistakes and circular problems which I am now aware of

That my understanding of my scientific field and the stance I take in it transformed during this research trajectory is of course the least to be expected. But what is there for others to learn out of my investigation? By conducting this research, I have:

- introduced ideas that are novel to current practices regarding interaction with scientific data in repositories, such as playful exploration (cf. chapter 1), video games for and out of repositories (cf. chapter 3) and storytelling with scientific images (cf. chapter 5)
- provided indications that these ideas are worth further exploring and implementing

- exposed some of the issues at stake when converting these ideas into concrete artefacts

The major contribution of this thesis is a broad but extensive investigation of playfulness as a desirable attribute of a scientist's interaction with scientific image data. We have argued elsewhere that playfulness is relevant for scientific practice in general and for exploring scientific image data in repositories in particular. Given our thesis, the question we asked was the following: What could playfulness with scientific images amount to and how do we design for it? Based on input from the literature, we selectively focused on associations as a relevant aspect of creative responses and insights over images. As a matter of fact, the notion of associations has been the common denominator in all the work presented in this thesis. To put it differently, we looked for, i.e. designed, implemented and evaluated, ways to produce gameplay that originates from a desire to exemplify or stimulate associations. In doing so, we have revisited current practices in playful and game-ful design within the domain of HCI. Rather than augmenting a task or interface with playful or game-full elements, our interfaces are playful in what they poke the user to do. At the end of the day, we can report on our own pitfalls, challenges, lessons learned and tensions identified during the development of our artefacts.

Section 6.2 briefly summarizes the key contributions of each chapter. For in-depth discussion, the reader is referred to the concluding section of each chapter. Here, we will mainly highlight novel concepts together with the findings that motivate further investigation of these concepts. Section 6.3 discusses some issues of importance to the design of playful interfaces. It offers a compilation of observations based on our practice which we hope to be of aid to other researchers interested in pursuing the idea of playfulness with scientific image data. Some of these observations have been addressed during our research trajectory, while others are suggestions for future work.

6.2 Summary of contributions per chapter

What could playfulness with scientific images amount to and how do we design for it? How do we produce gameplay that exemplifies or stimulates associations? What may be the added value of our interfaces/devised interactions? The preceding chapters have provided insight to such questions regarding the applicability of playfulness in the context of scientific image repositories.

Chapter 1, while an introductory chapter, provided a concise review on the core topics of this research. As such, it can be of relevance to (HCI) practitioners interested in scientific creativity, the role of images in the life sciences and the intersections of play and games with the domain of HCI. Based on literature, we introduced (a) playfulness as an attribute to be stimulated in interfaces to scientific image repositories and (b) associations as the focus point of play for the sake of exploration and creative responses to image data.

Chapter 2 proposed semantic annotation of image data as a viable approach to integration of image data across imaging modalities. As such, it emphasized the relevance and significance of connecting images for a better understanding of the phenomenon under study. Our work on the CSIDx database and interface highlighted the challenges of acquiring a complete annotation in a user-friendly manner. Visualization aids have been suggested to better exemplify the nature and structure of semantic, ontology-based metadata (cf. ontology viewer). Additional visualization aids have been introduced to better illustrate (attributes of) a result set as a whole (cf. search results visualization).

Chapter 3 introduced video games as 'executable' information visualisations, i.e. as a means to communicate the underlying structure of the data repository. Distinguishing of our approach is the requirement that gameplay should be directly derived from the graph structure of the dataset by enforcing a strong coupling between the game logic and the graph. The many potential mappings between game elements and graph elements open up a wide range of potential games and we consider our approach also an original strategy for producing new video games. The development of a concrete game allowed us to comment on the potential of video games as 'executable' information visualizations: Exposure to the game seems to contribute to the user's mental model of the data collection and data organization while converting an aspect of the system into something relevant for the player, e.g. score, allowed the player to react on an important aspect of the system, i.e. annotations.

Chapter 4 provided insights into user-moderated, image-based gaming activity in the Flickr photo sharing system. We supplied a first understanding of the various ways Flickr groups engage in play, a first categorization of the types of games played and some observations on the mechanics involved. Next to being a small step in classifying the rather unstructured environment of Flickr groups and games, our study contributes some suggestions on possible formats of gaming with images. Flickr games may not always comply to a strict definition of the term 'game', although they are clearly perceived as games by their initiators and participants. Considering activities without an explicit winning condition introduces

new directions for play and playfulness with images. What is more, we observed that players often value ambiguity as a source of play. Employing ambiguity as a design principle is another exciting direction that gaming with images can head in.

Chapter 5 introduced storytelling as a form of playing with scientific images. This chapter demonstrated a shift towards less rule-bounded play activities such as storytelling and a shift towards social aspects of scientific creativity. We observed that researchers can engage in storytelling with scientific images if properly prepared and prompted to. The development of a collaborative storytelling game for biologists and their images further allowed us to comment on the potential of storytelling with scientific images. By confronting the players with the challenges of story composition, the game has demonstrated a capacity of storytelling to probe an active look into and in between the images involved.

6.3 *In lieu* of design guidelines

This section summarizes issues we identify as important for the design of playful interfaces to scientific image collections. Truth is, we advocate that there can be no one-size-fits-all solutions when designing for playfulness. But if you find it worthwhile to study or create gameplay for playful interactions with scientific image data, our own practical experiences and, particularly, our false starts may be of some use. Subsection 6.3.1 discusses methodological and design challenges while subsection 6.3.2 discusses opportunities for future work. Nonetheless, the boundaries between the two are blurred as all identified challenges are opportunities for future work.

6.3.1 Points of tension, points of attention

Interface design *vs* Game design

The games produced during this research were created mainly by means of HCI methods. In particular, the design iterations of Onto-Frogger were predominantly focused on the interface of the specific game while the development of LABBOOK was, in part, an effort to extract requirements by considering our users' reactions to storytelling with scientific images. We have discussed elsewhere the significance of a well-designed interface for the experience of the user/player and for the success of the platforms we like to call playful interfaces for exploration. That said, we realize that more experimentation regarding the game concepts of our artefacts would have been welcome. Note that the same HCI practices, e.g. fast

prototyping, user-centred design, etc., can be still employed but with a different objective, i.e. an appropriate set of game rules.

The impact of the interface, in one hand, and of the game concept, on the other, to the overall quality of a prototype is a cumbersome issue. When a prototype 'fails', is it the interface that is inappropriate or the game concept? How far should one improve on the one (and which one?) before rejecting the other? This circular trap has implications not only for the evaluation of a prototype but also for the evaluation of the research question the prototype relates to. Our research methodology was to, a great extent, based on the following assumption[1]: That the design of artefacts can promote understanding by, firstly, confronting the researcher with the challenges of making concrete products out of theoretical propositions and, secondly, by providing a tangible tool for the researcher to interact with the users. Unavoidably, this approach suffers from the same circular trap: When an idea 'fails', is it the prototype that is inappropriate or the suggested theory? We have decided to ignore this loophole by accepting that our artefacts are not controlled experiments to prove our theories but probes for a useful exchange with our users.

Designing for users *vs* Designing with users

As far as we are entitled to say, this research has been be user-centred for placing the interests and experiences of our users at its core. Yet, we are fully aware that one can not design an experience and that, regardless of how grounded our theoretical propositions are, users will respond to our ideas and artefacts in their own unique and situated ways. Eventually, the only value or usage our artefacts can aspire to is not the one we predict but the one our users will assign or discover in them. This realisation is particularly relevant when introducing new practices that do not necessarily reflect the articulated needs or established workflows of a user group. In this case, we can only invite our users to consider the practices we believe worthwhile. While doing so, we need to resist the urge to prove our ideas and remain open to what our users may make of them.

There is much we can learn from our users, also in exchanges other than user evaluation sessions. Our Flickr study (cf. chapter 4) is a straightforward example of turning to a community of players in order to learn from their own self-initialized and self-moderated practices. More opportunities to learn directly from our target user group would have been appreciated. By this, we refer to both opportunities for observation as in ethnographic studies, research in the

[1]The notion of research-through-design as discussed by Zimmerman et al. (2007) is relevant but not exactly equivalent to our approach.

wild (Chamberlain et al., 2012), etc. and opportunities for participatory design. Empowering the users to imagine and create their own interactions would have added an entirely new dimension to the ideas presented in this thesis.

Playing with images: Gamification *vs* Design for playfulness

The artefacts produced during this research have been intended as playful interfaces to scientific data. We devised and investigated possible ways to literally play with scientific images in manners that would potentially stimulate exploration as in identifying patterns, making associations, embracing ambiguity and participating in social exchange. Our approach has been diametrically opposed to superficially layering playful or game-full element in an existing application. And while most of our outputs are comparable to serious games, we acknowledge that making playful interfaces does not necessarily equal with making games. Nor is making games a panacea when playfulness is the objective. What we mean to say is that, in order to support play for exploration, making games is not enough. Making games that focus on what is intrinsically valuable and relevant for exploration may be a step in the right direction.

Onto-Frogger and LABBOOK were both driven by the same interest and motivation but are two very different games. Out of their many differences, we would like to highlight that Onto-Frogger values and utilizes the formal rule structure of a game while LABBOOK values and utilizes storytelling as a form of free and creative play. Without dismissing the potential of rule-bounded games, we come to realize that unstructured play activities may be more appropriate towards supporting exploration and creativity. Next to playing as gaming and playing as creating (stories), a notion of play that is still pending our investigation is the notion of playing as having freedom of control. This research has considered playful exploration as in browsing, building a mental model, establishing associations, actively looking into entities but it is still to consider exploration as in being in total control in experimenting with options and alternatives.

6.3.2 Future challenges, future directions

Interacting with images: Pixel data *vs* Metadata

From the onset of this project, our affirmation was that images from the life sciences are composite entities of pixel data and metadata. Image captures without metadata are, to put it mildly, unusable for a data repository and for other researchers. Our interest in associations runs in parallel to our interest in metadata, in particular semantic metadata that provide an integration of images over

subject matter. The projects developed during this research range from communicating existing connections based on metadata to establishing new connections between image entities. In both cases, our focus lies in whatever useful knowledge or insight exists in the space in-between image entities. However, and as our storytelling game indicates (cf. chapter 5), there is plenty of useful input in the pixel content of a single image. Therefore, an active look into a single image is a contribution we would like to push further. Potentially, our notion of video games as 'executable' information visualizations could be expanded to the pixel level. A game that is an 'executable' visualization of a single image would require that aspects of the pixel content of the image are properly encoded into the rules of the game.

Interacting with images: Single image entities *vs* High-throughput images

This thesis has considered the role of images in a research trajectory and the contribution of image-based observations as signposts in ongoing research. While we consider an image entry, i.e. pixel data and metadata of a single capture, as self-contained, we are more and more aware that a shift is mediated by the predominance of high-throughput imaging in the life sciences. The outputs of a high-throughput experiment involving imaging are better consumed and incorporated in the form of graphical representations of derived numerical data. The captured snapshots are simply too numerous to inspect, although they will be consulted and inspected once an interesting outlier in the graphic is found. Playing with images could be easily propagated into playing with graphs while the notion of associations is particularly forgiving about the type of data to be contrasted, compared and linked.

Interacting with images *vs* Interacting with researchers

This thesis has considered ongoing research in scientific practice as a process of transformation, i.e. a process of refining one's research experiments and choices by incorporating image-based observations. Such observations can be facilitated by various mechanisms such as a new look into one's own image data, a new association between one's own image data and one's repository of background knowledge, or a new association between one's own data and the data of another researcher. This approach can be understood as an image-centred one and one that assumes that the observation, negotiation, synthesis or inference occurs as the researcher solely processes hers or others' image data. However, we have been increasingly aware of the importance of social exchange and conversation

during a research trajectory. Exposure to the images of other researchers is undoubtedly beneficial but so is exposure to other researchers themselves. We suggest that future instances of playful interactions with scientific images should further examine the role of social interaction and exchange. In other words, playing with scientific images should be further expanded to also consider playing with other researchers.

6.4 Wrapping it all up: A plea for true playfulness and another one for true participatory design

If I were to start all over again, I would have done it all differently. This is not to say that the turns I took were the wrong ones, only that I now have a different perspective on and understanding of the possibilities and directions to be explored. Even so, I am confident that the part of the road that was travelled was not for nothing. When me or any other researcher wish to study, employ or exploit play and playfulness with scientific images, we will not start entirely blind.

This thesis will now conclude with a plea. Forget about gamification, forget about playful interfaces. When designing for playfulness and/or exploration, try to understand what is inherently useful and playful in scientific practice or any other task in hand for that matter. And build your games, interfaces or experiences with this element at the core. As far as methodology is concerned, make it truly participatory as early as you can. You will be surprised how much your users can do.

All things considered, I still believe that coupling playfulness and scientific data is a worthwhile idea. Up to this point, I have tackled only a small subset of what playing with scientific images can be; the rest is up to you.