Extended abstract / summary

Creativity workshops (workshops which employ techniques aimed at deliberately stimulating creative thinking) of one form or another are commonly used in design and problem-solving. They have been used in the early stages of developing various kinds of interactive systems, but seldom, to date, for the design of data visualization. One exception is Goodwin et al. who describe creativity workshop focusing on energy analysis visualization. Following the format described in (Goodwin et al), we have run two further creativity workshops to support the design of visualizations in neuroscience and optimization. On the basis of our experience of doing this, as well as the reflections provided in Goodwin et al, we propose a *visualization creativity workshop*. While our proposed workshop is similar to the technique described by Goodwin et al, we elaborate on that in three main ways: 1) we analyze the connection between creativity workshops and existing visualization design methodologies 2) we provide a detailed description of workshop activities including a reflection of their effectiveness as well as proposed modifications and alternatives; and 3) we reflect on how to use the workshop's output to positively influence the visualization design process. Our goal in writing this paper is to provide a framework for visualization designers who are considering the use creativity workshops.

What is creativity?

- Should we make a distinction between "creativity" as making something novel, and deliberate creativity-based methods.
- *The ability to produce work that is both novel (i.e., original, unexpected) and appropriate (i.e., useful, adaptive concerning task constraints)* [Sternberg1999]
- Creativity models

Lit review: collective/group creativity as related to workshops [in progress]

- Why rely on collective creativity? It's greater than individual creativity; labs work in groups.
- Using explicit creativity-based techniques for requirements gathering in software had been done by Maiden et al. [Maiden2007, Maiden2004a, Maiden2004b, Maiden2005]
    - To what extend do these talk about creativity *workshops*?
- Maiden has looked at: are workshop results inherently more creative than 'practical' requirements gathering methods? Though these workshops were oriented heavily on analogical reasoning with two very-specific domains. [Maiden2007]
    - Describes workshops used in requirements analysis consisting of:
        - Presentation from a professional e.g., museum curator or TV scheduler
        - Brainstorming about how that domain could apply to ATC
        - Removing Constraints
        - Analogical Reasoning
        - Use Cases and Storyboarding
    - Connects workshop activities to three models of creativity

  - CPS model "divergence and convergence toward ideas" and "techniques that encourage creative thinking" [Osborne1953]
  - Three types of creativity: exploratory, combinatorial, transformational [Boden1990]
  - Four essential creative processes – preparation, incubation, illumination, and verification [Poincar1982]

Lit review: the use of creativity workshops in computing but outside data visualizations

- Where has creativity been used in HCI and other fields?

Lit review: creativity workshops in data visualizations [have looked at JD and SG's previous papers. not sure if there are others in this area]

- Where have creativity workshops been deliberately injected into visualization design?
- How is our paper different from SG and JD's papers on creativity in visualization design?

Where do workshops fit into existing methodologies?

- Our experience is with three workshops conducted during design studies which are "project in which visualization researchers analyze a specific real-world problem faced by domain experts" [Sedlmair2012].
- The "learn" and "winnow" and part of the "cast" phases of the DSM are outside the scope of our reflection on creativity workshops. We will assume that a set of potential collaborators has already been identified and meet criteria for a design study.
  - Interesting visualization research problem
  - Real data
  - Real need for visualizations
- The workshops fit into the DSM's *core* phases – discover and design:
  - Discover – "learn about the problem domain and the practices, needs, problems, and requirements of the domain experts in order to discover if and how visualization can enable insight and discovery" and "establish a shared understanding"
  - Design – "generation and validation of data abstractions, visual encodings, and interaction mechanisms" with an emphasis on "broad consideration space" and "narrow proposal spaces"
  - Implement – is about the "implementation of software prototypes and tools" with an emphasis on rapid prototyping and throw-away code
- Another way to think about the core phases is using the vocabulary of the design activity framework with quotes from [McKenna2015]:
  - Understand activity – "to gather, observe, and research available information to find the needs of the user"
    - Opportunities – data and tasks that have potential impact for users
    - Constraints – rigid limitations of the project
    - Considerations – looser limitations of the project

  - Ideate activity – "to generate good ideas for supporting the understand outcomes"
  - Make activity – "to concretize ideas into tangible prototypes"
- Given the vocabulary of the design activity framework, the goal of creativity workshops spans from the *understand* activity to the *ideate* activity.
  - The un-analyzed workshop output varies with activities and day structure, but analyzing this output results in a tangible set of opportunities, constraints, and considerations.

Motivation for running creativity workshops in visualization projects. (Why do the workshops?)

- The creativity workshops establish trust, rapport, and buy-in with collaborators. This is especially true when working with large organizations where the collaborator's main contact is not the only analyst.
  - One consideration of working with collaborators not discussed in the DSM is: what will they gain from working with you? How to get them invested in the project's success?
  - DSM recognized importance of collaborator buy-in when they state that "if there is not enough time available for activities such as problem analysis, design discussion, and field evaluations, then success is unlikely" [Sedlmair 2012]
  - Creativity workshops offer a way to deal with varying levels of engagement within labs, generate collaborator buy-in, build trust and establish rapport with analysts and others in the lab.
- Creativity workshops bring together collaborators with different roles, backgrounds and perspectives – leading to a broader search space of designs and creating tools which may be more generalizable.
  - The traditional methods for understanding needs tend to be highly individualized [cite contextual inquiry and unstructured interviews papers].
  - This makes it time consuming for visualization designers to truly sample the needs of an organization – requires multiple meetings with individuals of different specialties.
  - It is up the visualization designer to both learn the new fields, and find parallelism between the needs of various user roles.
  - Creativity requires diversity [Sanders2011?]
- Creativity workshops provide an accelerated understanding for visualization designers.
  - This gives visualization designers many more man-hours of collaborators in a very short period of time. Much less of a hassle than extending traditional understanding methods to many weeks.
- Creativity workshops provide benefit to collaborators.

- Although the focus is on visualization design, the creativity workshops allow collaborators to discuss their current challenges in a creativity atmosphere.
- Quote from RM about "exposing shared needs" and "egalitarian atmosphere"
- In all three projects, the workshops were established as being mutually beneficial for all designers and collaborators. This helped bring the collaborators to the table and give us a day of their time.
    - WS #1's goals: Visualization: to use creativity techniques for requirements gathering for infovis; Collaborator: to deliver insights into the role of Smart Homes and new business potential, through creative engagement with customers and visualizations of new datasets.
    - WS #2's goal Visualization: problem driven research to create novel visualization techniques for multi-variate graphs and multi-typed dataCollaborators: basic descriptive neuroscience research – understand cells in the mammalian retina
    - WS #3's goal: Visualization: to convince collaborators that they need well-designed visualizations; Collaborators: explore, extract and implement stats and visuals to aid users in profiling complex CP models.

When to do the workshop during your project?

- The workshops require some initial understanding of the problem domain and some initial data abstraction. How much initial understanding did each workshop have of the problem domain?
    - WS #1 –
    - WS #2 – we had conducted roughly five hours of contextual inquiry and unstructured interviews. We wanted a rough understanding of domain and vocabulary before running the workshop.
    - WS #3 –

Preparing for the workshop. (Who should participate? Where should you do? How much formal preparation is necessary?)

Who should participate and facilitate?

- Who should participate?
    - Large breadth of roles, if possible.
    - Select for creativity with questionnaires [WS #3]
- Who should facilitate?
    - Comfortable leading seminars

Where should you do it?

- "Creative space" – neutral, well lit, plenty of space

How should you prepare for the workshop?

- Pre-workshop surveys
- Appropriate materials – color coded post-it notes for each activity;
- Hard copies of activity prompts
- Homework for participants – open point of discussion

Overview of the day's structure - where did the overall structure come from? [depends on lit review]

- The day's structure can be thought of on different axes:
  - Divergent -> convergent
  - Generative -> evaluative
  - Understand -> ideate
- Where to hold the workshop?
- Who to participate in the workshop?
- How to establish a creative atmosphere?

Detailed description of each activity, discussion of effectiveness from all three workshops, proposed alternatives [nearly finished]

Discussion of how we structured, analyzed, and used workshop output in the visualization design process [in progress]

- The various activities throughout the day generated a few hundred discrete artifacts—post-it notes, prompt sheets, photographs, and drawings.
- In all three workshops, we analyzed these artifacts, along with our facilitator notes, to identify key themes or categories of ideas.
- Analysis is an iterative and time consuming process—there is a need for "reflection" [Sanders2011]
- Performing this categorization with one of our collaborators helped with the problem of translating domain-specific terms into abstract terms.
- Different ways of handling output for the different workshops:
  - WS #1 – recorded all aspirations and analogies in a spreadsheet; identified **key themes** of the day; these themes were rated (by facilitators) as feasible vs infeasible; the feasible ideas were passed to designers in a "design workshop."
  - WS #2 – recorded all artefacts in the spreadsheet; performed an open coding in collaboration with a participant identified ~10 themes – which are **opportunities** for visualization design; also identified constraints and considerations for our projects.
  - WS #3 – identified topics**, themes and tasks** : 22 themes and six analytical tasks; prioritized themese based on
    - "ease of development"
    - "impact values"

- Goal of WS1 and WS3 – requirements discovered during the workshop were used formulate questions of the data. The prototyping stage was used to test hypothesis about how useful the questions would be and to identify visual patterns.
- It might be neat to have a figure showing how each of the three projects used outputs from the workshop. Along with quotes

Pitfalls / guidelines as a secondary contribution [not sure if these will fit into the paper]

- High resolution projector for showing examples
- Plan B for activities that might fail
- Flexibility of time management
- Focus on data: characteristics, abstractions, and tasks
- Adequate time for breaks
- Not knowing roles of personas in the domain