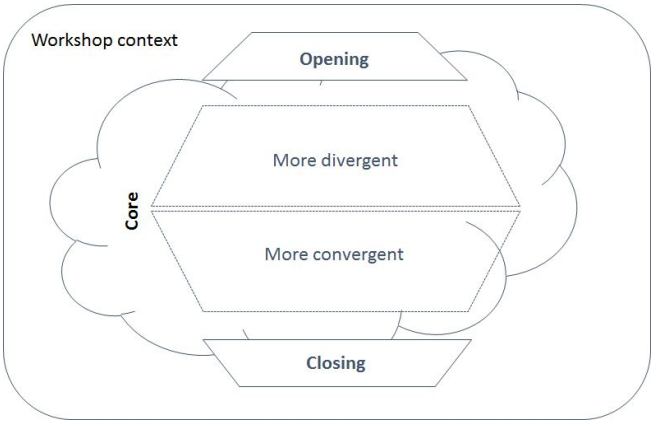
Workshop Design: Structure, Examples, and Considerations

The previous section described the workshop process but glossed over the details of designing workshops. This section unpacks workshop design concepts. It starts with an overview of workshop structure, an outline of how methods form a coherent workshop. It illustrates the workshop structure by relating it to an example workshop plan that has been validated in three projects [P2,P3,P4]. It concludes with details on workshop design, such how to tailoring the example to specific projects and moving beyond the template to select methods for entirely new workshops.

Workshop Structure

The **workshop structure** is an abstract pattern of methods in a workshop, shown in Figure X (below). Within the **workshop context** of an applied visualization collaboration, the structure consists of three abstract phases of workshop methods. First, the **workshop opening** establishes intent, preparing participants for productivity and creativity by promoting trust and agency [Brooks-Harris1999]. Second, the **workshop core** provides methods that encourage deep creative thought, enabling participants to explore ideas and express concerns --- often in cycles of generating ideas followed by evaluating ideas [Gray2009]. Third**,** the **workshop closing** concludes the workshop, validating the time and energy that participants invested in the workshop --- supporting continued creative collaboration [Hamilton2016].

The structure applies, to some extent, to *every workshop* in our experience. It is supported by creativity workshop literature that identifies differences between the beginning, the middle, and at the end of workshops [CreativeEducationFoundation2015, Gray2009,Hamilton2016, Gordon1961]. It is an abstract thinking tool useful for designing and analyzing creativity workshops. More specifically, the goals of each phase provide criteria for us to evaluate potential workshop methods. The remainder of this section describes intent of the workshop opening, core, and closing.



Caption: A general structure for workshops designed in the context of an applied visualization research project. The workshop opening communicates its intent and purpose. The core supports ideation and exploration, often in cycles of divergent and convergent thinking. The nebulous shape of the core represents the emergent and unpredictable collective creativity. The closing concludes the workshop, establishing next steps for action.

Workshop Opening

The workshop opening is the start of the workshop. It prepares participants for a productive and creative experience. Effective openings communicate the workshop intent, provide agency, and support trust. This supports open communication necessary for group creativity..

Intent. All of our workshops have started with a short (<5min) presentation to explain the purpose of a workshop in the context of a project and to communicate our intent that participants engage in deep creative thought. Creative thought is supported By encouraging participants to suspend judgement [Osborn1953], to commit to the entire workshop [Hamilton2016], and to think deeply about concepts [Sawyer2006]. Specific examples of how to communicate the intent and context are shown in our example workshop. Yet this may not be enough, the workshop opening also engages participants, priming them for a productive day by providing agency and supporting trust.

Agency. Agency is the feeling of ownership, responsibility, and ability to act [Merriam-Webster2017]. It is important to promote agency early in the workshop with active methods that require multi-directional communication and provide participants an opportunity for self-expression [Brooks-Harris1999]. Methods that encourage the one-way communication, such as lectures, hinder agency [Lloyd2011]. Yet, this is a mistake we made in two workshops [DiscoveryJam2016, P8] as lectures force participants to idly listen to a presentation.

Trust. Group creativity relies on the open communication of ideas between participants [Sawyer2003] and open communication often relies on trust, the confidence that participants place in each other and in the workshop team [Jones1989]. It can be encouraged by showing intent to listen, and demonstrating vulnerability [Brooks-Harris1999]. Participants remarked on the effectiveness of trust-building methods:

"the interpersonal leveling and intense re-visiting of concepts made more team progress in a day than we make in a year of lab meetings."

Workshop Core

After the opening, the workshop transitions to the core where ideas are generated, explored, and evaluated. While there are practically infinite possibilities for the workshop core, reflection on our experience illuminates common concepts that we have found useful for designing workshops: the ideaspace; the visualization, data, analysis and automation context; externalization; connection; and incubation.

Ideaspace. Creativity methods can be characterized by their influence on an ideaspace, the abstract set of all ideas being considered by participants [Biskjaer2017, Osborn1953, McKenna2014]. **Divergent methods** generate ideas and expand the possible ideaspace. **Convergent methods** evaluate ideas and winnow the possible ideaspace. Workshops consist of repeated **diverge-converge cycles**, exploring a broad space of possible ideas before selecting the more promising ones [CreativeEducationFoudnation2015, Osborn1953, ...]. Diverge-converge cycles occur *between methods* as workshops start with divergent methods, such as *brainstorming* to generate ideas followed by prioritizing or ranking those ideas in groups discussion [P8]. These cycles can also occur *within methods* such as in a requirements workshop with geographers [P1], where participants diverged, generating ideas about a certain topic, and then converged, highlighting the more important or interesting ideas.

Externalization. Workshop methods should be selected, in part, by the artifacts that they produce as physical artifacts influence creative thinking and the analysis of workshop results. Externalization supports creativity as articulating ideas physically starts a feedback loop that forces idea evolution [Sawyer2006]. Externalization supports workshop analysis as the physical artifacts can be analyzed by the workshop team. Examples of effective externalization are methods that create physical representations of ideas, such as post-it notes, sketches, or other physical representations. Methods without useful artifacts include unstructured group discussion. The externalization also allows methods to be connected into a coherent workshop.

Connection. The connection between methods allows for ideas to evolve throughout workshop. This is important as one benefit of workshops is that they allow for revisiting of concepts to discover emergent requirements. Methods can be connected explicitly, for example, by generating ideas on post-it notes and then clustering or ordering those post-it notes. Methods can also be connected implicitly, for example, by asking participants to create new ideas based on previous discussions.

Incubation. Providing time to incubate**,** or to think about ideas both consciously and unconsciously is an important part of creative thinking [Sawyer2006], and should be integrated into workshops. We have supported incubation in shorter workshops by providing unstructured breaks between methods [P6]. In longer workshops, we provided breaks for lunch. Reflecting on the impact of incubation on one workshop [P2], the a workshop team member described the incubation during lunch: *"Conversation just*

flowed well! The morning had prompted a lot of ideas and there was a really interesting and diverse discussion over lunch about the subject and possibilities in the area. I expect this was partly also due to the fact that everyone was forced to eat at the neutral venue - lunch was served in a really nice dining area, no decisions had to be made...There were no distractions. So we just continued to discuss the topic."

Workshop Closing

The workshop core concludes with convergent methods that segue into the workshop closing. The workshop closing concludes the workshop, providing participants providing participants with a sense of closure through reflection on their experience and validation of their efforts. The workshop closing is also an appropriate time to encourage participant feedback.

Reflection. Most of our workshops have concluded with a reflective methods, asking participants to think about their experience in the workshop. A common example is to ask participants to discuss interesting ideas from the day. Reflection can provide important information for the workshop team about what participants found most interesting, guiding the analysis of workshop results. The reflection also reinforces the workshop effectiveness as ideas have often evolved beyond the initial methods at the start of the day.

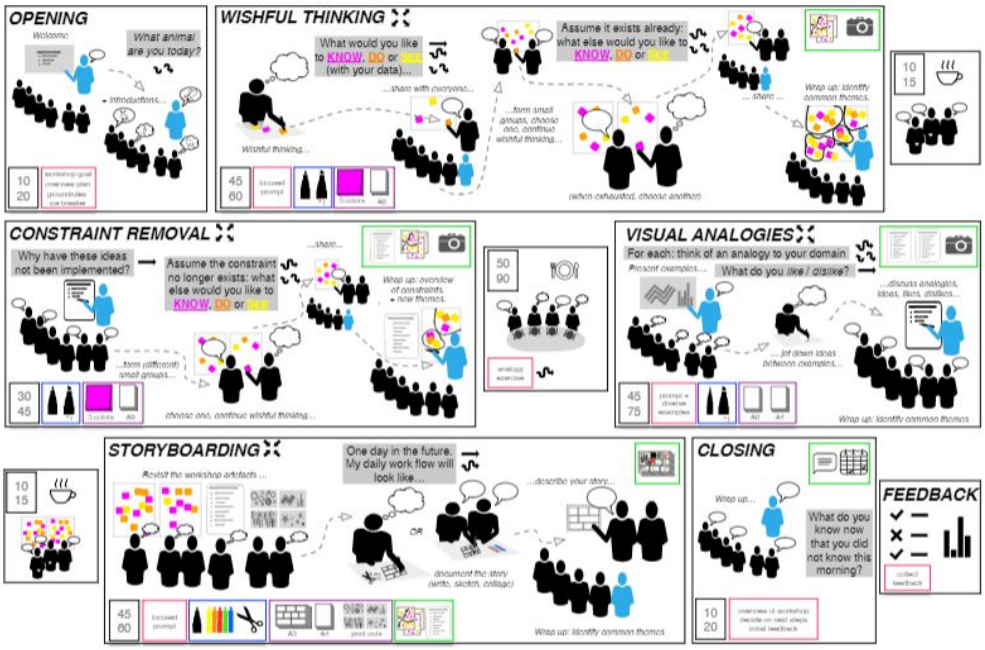
Validation. The workshop closing is an opportunity to provide participants with a sense of validation. This includes thanking participants for their participation in the workshop. It is also important to communicate the next steps of the project, to validate that participant's energy will influence the direction of the collaboration [Hamilton2016].

Feedback. The closing is also a time to ask for feedback on the workshop. This includes communicating surveys to participants to asking for feedback through other methods.

Following the workshop, ideas and artifacts from it are analyzed. The analysis drives forward the visualization project by identifying areas for future work, exposing shared user needs, and establishing criteria for evaluating ideas.

Illustrative Example Workshop

This section describes an example six method, full day workshop --- shown in Figure X (below) --- as an illustrative example of the workshop structure. This example workshop has been validated in design studies with energy analysts [P2], neuroscientists [P3], and constraint programmers [P4]. It can serve as a starting for researchers considering workshops in their own projects.



Caption: An example workshop based on our successful experiences [P2.R,P3.R,P4.R]. The opening method establishes intent and primes for creativity. Divergent methods --- *Wishful Thinking, Constraint Removal,* and *Visual Analogies* --- explore a broad space of ideas. The convergent method --- *Storyboarding* --- winnows promising ideas into coherent narratives. A reflective discussion serves as the closing, providing validation and closure.

Workshop Opening

The workshop begins with a two method opening. First, a short presentation communicates guidelines for the workshop that are intended to foster a creative atmosphere. An example set of guidelines [P2] includes:

- *All ideas are valid – record them;*
- *Let everyone have their say;*
- *Be supportive of others;*
- *Don't trash other people's ideas – use them to create additional ideas (2 ideas rather than 0);*
- *Think 'possibility' – not implementation*;
- *Speak in headlines and follow-up with detail;* and
- *Switch off all electronic devices!*

Next, an ***Analogy Introduction,*** provides agency and supports interpersonal leveling as the workshop team and participants introduce themselves through analogy, such as *"What animal are you today?"* Reflection on this experience reveals [P2]: *"the animal introductions required some audacity on the part of our facilitator...it seemed useful preparation for future exercises in initially putting all participants on an equal footing."*

Workshop Core

Following the opening is the workshop core. The core starts with a divergent active method ***Wishful Thinking***, that elicits participants' aspirations for visualization software. Prompted with a scenario in their domain, participants respond to the following three questions on post-it notes: *What would you like to be able to see? What would you like to be able to know? What would you like to be able to do?* Participants share ideas through group discussion before generating more ideas in small groups.

Following a short break, the output from *Wishful Thinking* becomes input the divergent, active method ***Barrier Removal*****,** where participants identify and record barriers to their current aspirations before they are asked to 'remove' barriers, imagining what would be possible if the barrier no longer existed. These ideas are recorded on post-it notes. *Barrier Removal* demonstrated effective connection between methods, as ideas from the previous method are used to generate additional ideas. Next, time for lunch is provided to allow for incubation and unstructured discussion.

After lunch, the participants return to a divergent, passive method ***Visualization Analogies*** where participants are shown a variety of visualizations and record ideas about how the visualization may apply to their domain. This method is similar to *visualization awareness workshops* [Koh2011], and serves to engage participants and allow them to specify requirements by example. It is followed by another short break.

After the break, a convergent method, ***Storyboarding,*** is used to winnow the ideas into coherent narratives as participants depict "a day in their life" while imagining the impact of topics from the workshop. Storyboarding is implicitly connected to the previous methods.

Workshop Closing

The workshop concludes with a reflective closing method where participants are asked *"what do you know now that you did not know this morning?"* Because this question is intended to start a discussion, it requires participants prioritize their thoughts to talk about the more interesting ideas.

Method and Workshop Design Considerations

The example workshop is a starting point for thinking about workshop design. This section presents differences between the workshops in action. These low-level differences reveal the subtleties of workshop execution. They provide a foundation to examine higher-level considerations with respect to designing workshops.

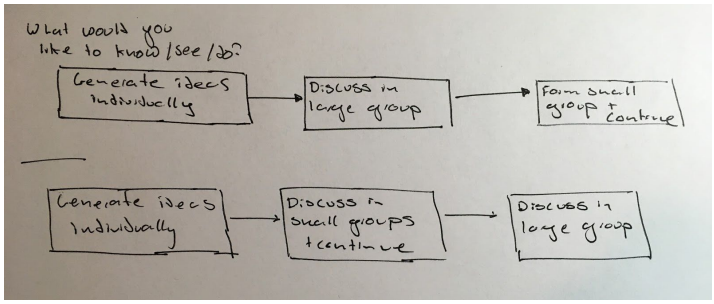
Example Workshop in Action

Analysis of our experience using the workshop revealed key differences in our workshops and their execution. Although following the same structure, we tailored the workshop to specific projects, accounting for the context, for our visualization expertise, and for our execution experience.

Context. We adapted the methods to the specific workshop context within an applied visualization collaboration as illustrated by prompts of the *Wishful Thinking* method. Our collaboration with energy analysts focused on long term aspirations for smarthomes as we asked participants to: *"think about aspirations for the Smart Home programme ... 'What would you like to know?', 'What would you like to be able to do?' and 'What would you like to see?'"* In contrast, working with constraint programmers examined shorter-term goals and concrete analysis tasks: *"Your program does not execute as expected...[what would you like to know/see/do]?"* A similar concrete aspect was used in the neuroscience workshop: *"Suppose you are analyzing a connectome, [what would you like to know/see/do?]"* This workshop also used screenshots of existing tools to stimulate ideas. These differences propagated through the day as the aspirations form a foundation for discussion throughout the workshop.

Expertise. The expertise of participants and the workshop team will influence how methods are presented as shown in the *Visual Analogies* method. Specifically, the visualizations presented in this method require judgement from the facilitator to select appropriate visualizations. We have generally selected a mix of seemingly unrelated visualizations (to promote divergent thinking), visualizations that you created (to show authority and credibility), visualizations that you did not create (to show knowledge of the field), older visualizations (to show depth of knowledge), and playful visualizations (to support many styles and many paths). This method has generated many interesting discussions, such as *`what does it mean for legends to move?''*, *``what does it mean for energy to flow?''*, and *``what does it mean for neurons to rhyme?''*

Execution. While using the same methods, they can follow different processes, the plans for execution. One example of this is how we used the Wishful Thinking method with different processes (shown in Fig. below). One relied on individual ideation, discussion as a large group, then small group ideation. The other relied on hierarchical aggregation of ideas, moving from individuals, to small groups, to large group discussions. Each one depended on the atmosphere, the relationships and experience of the workshop participants and the workshop team. Another execution-specific consideration is related to how participants are shuffled during different methods. Many options available for shuffling participants include stratified shuffling: by organization (VIS person vs. domain specialist), seniority, gender, specialty (infovis, scivis, vast, domain scientist). Other options include random shuffling, or shuffling directed by the facilitator.



Caption: Two processes for the same method *Wishful Thinking.* In one case, individuals generate ideas, the ideas are discussed in a large group, and participants form smaller groups for continued ideation. In another case, participants generate ideas, participants discuss ideas in small groups and continue ideation, then ideas are discussed in the large group.

The example workshop is one point in a large space of possible creativity requirements workshops. It can be condensed, for example, by only including the Opening, Wishful Thinking, and Conclusion [P6]. Or it can be expanded, by adding additional methods to generate ideas, such as unstructured ideation [P8]. There are also wildly different workshop structures that use different methods to identify opportunities for visualization or visualization scenarios, for example [P1,P2]. In all of these cases, the workshop structure---opening, core, and closing---describes the methods used and the intent of methods.

Workshop Design Considerations

Our discussion of workshop design has avoided concrete recommendations because the possibilities for workshops are unbounded. We encourage the design, use, and reporting of new workshops, by selecting methods appropriate for a given project. This section describes considerations for designing future workshops, including resources for selecting methods and tailoring methods to visualization projects. Additional considerations include framing methods as *creativity support tools* to evaluate their potential effectiveness. And low-level vocabulary for method mechanics is provided.

Method resources. There are a plethora of resources describing creativity methods potentially useful for creativity workshops. A short of list resources, though not exhaustive, may be useful for designing workshops. Kumar [Kumar2012] describes 101 design methods useful for teams that need to be adapted for use in a workshop setting. McKenna et al [McKenna2014] provide 100 exemplar methods relevant for visualization researchers but these methods may need to be adapted to a workshop setting. Gray et al. [Gray2009] describes *games*, methods that encourage creative thinking and can be chained together into workshops, though they will likely need to be adapted to maintain an appropriate focus on data and visualization as described by the context.

Method context. When using methods from existing resources, careful attention should be paid to the method context, how the methods explore the relevant data, analysis workflows and automation of a domain. The **data context** is how a method incorporates domain data and whether it is investigating perception of data or real data. The **analysis context** describes how the method relates to the analysis needs of domain collaborators. A concrete analysis context examines the existing workflows,

conventions and tools. The **automation context** explore the role of automation, an important part of applied visualization research that aims to balance between information location and task clarity [Sedlmair2012]. The **visualization context** describes how methods explore the role of visualization. Visualization features can be implicit by using visual language or asking about visualizations without directly showing them.

Creativity support. Framing methods as *creativity support tools* provides valuable criteria for designing a workshop. In their summary of creativity support tools, Shneiderman et al [2005] proposed the following guidelines for creativity support tools that also apply to creativity workshop methods:

- *Support collaboration and communication* - methods should provide opportunities for participants to work together and support communication by explicitly externalizing ideas
- *Provide low barriers, high ceilings, wide walls* - methods should provide opportunities for everyone to contribute with undefined stopping conditions and allow for exploration of ideas.
- *Make it as simple as possible* - methods should focus the energy of participants on the ideas of the workshop, instead of understanding how to complete a method.
- *Invent things that you want to use yourself* - the workshop depends on engagement of participants, which can be fostered by selecting methods that they want to complete.
- *Support many paths and many styles* - methods should support the different styles of workshop participants, by using mechanics as described next.

Method Mechanics. The method mechanics are commonly recurring theoretical constructs that describe the intended thoughts or actions of participants. The method structure, ranging from unstructured brainstorming, to structured Wishful Thinking, influences engagement. Critics point out that unstructured ideation wastes time [Chamorro-Premuzic2015], but feedback from participants revealed that a mix of structured and unstructured methods may be most effective. Related to structure is the framing, the desired mindset of participants [Nickerson1999]. Examples of framing include methods that ask participants about previous failures of software (negative framing) or successes of existing software (positive framing). Methods can also be selected based on creativity triggers**,** the type of creative thinking that methods try to stimulate. A common trigger used in workshops is analogy, the transfer of concepts between domains [Goel1998]. Other triggers include metaphor [Gordon1961], combination [Boden2004] and analytical/intuitive processes [Miller1987]. A mix of mechanics should be used to encourage creativity, supporting many paths and many styles.

Limitations of Workshop Design

The considerations presented in this section are a starting point for designing workshops. They are resources and tools for describing methods in the abstract. They do not account for the complexities of human thought [Sawyer2006], the emergent nature of group creativity [Sawyer2003], nor the serendipitous interactions that workshops support [Brooks-Harris1999]. Ultimately workshop design involves working out which of a set of methods we might use and what effect they might have on the workshop. But the workshop execution requires flexibility in terms of execution process and in light of unpredictable reactions that occur during the workshop.