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# Affinity+: Semi-Structured Brainstorming on Large Displays

**Russ Burtner**

Pacific Northwest  
National Laboratory  
902 Battelle Boulevard  
PO Box 999  
Richland WA  
russ.burtner@pnnl.gov

**Richard May**

Pacific Northwest  
National Laboratory  
902 Battelle Boulevard  
PO Box 999  
Richland WA  
richard.may@pnnl.gov

**Randy Scarberry**

Pacific Northwest  
National Laboratory  
902 Battelle Boulevard  
PO Box 999  
Richland WA  
randy.scarberry@pnnl.gov

**Ryan LaMothe**

Pacific Northwest  
National Laboratory  
902 Battelle Boulevard  
PO Box 999  
Richland WA  
ryan.lamothe@pnnl.gov

**Alex Endert**

Pacific Northwest  
National Laboratory  
902 Battelle Boulevard  
PO Box 999  
Richland WA  
alex.endert@pnnl.gov

**Abstract**

Affinity diagramming is a powerful method for encouraging and capturing lateral thinking in a group environment. The Affinity+ Concept was designed to improve the collaborative brainstorm process through the use of large display surfaces in conjunction with mobile devices like smart phones and tablets. The system works by capturing the ideas digitally and allowing users manually sort and group them on a large touch screen. Additionally, Affinity+ incorporates theme detection, topic clustering, and other processing algorithms that help bring structured analytic techniques to the process without requiring explicit leadership roles and other overhead typically involved in these activities.

**Author Keywords**

large display, natural user interface, ubiquitous computing, brainstorming

**ACM Classification Keywords**

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

**General Terms**

Algorithms, Design, Human Factors



**The “MURAL” large, high-resolution display at PNNL used for Affinity+.**

This interactive powerwall provides multi-touch capabilities on a seamless, 16 ft. x 7 ft. display. MURAL is rear-projected using 12 projectors to achieve 15.4 megapixels of total resolution. The multi-touch overlay uses the Windows 7 API, allowing over 20 simultaneous touch events for small group collaboration sessions.

## Introduction

Affinity diagramming is a fairly common strategy for groups of participants to brainstorm ideas and classify them [1]. Each participant uses sticky notes to write down an issue or idea, one concept per sticky. They then post them on a tear sheet and work as a team to manually cluster and classify them in an affinity diagram as themes and topics (Figure 1). These themes are then discussed and voted on to help prioritize and further organize them. This entire process is usually manually documented in photographs and detailed notes to capture the session and the ideas that were generated. These sessions often span multiple days, and thus maintaining the state of a session requires designated locations where the sticky notes can be kept. Further, while the physicality and flexibility of the sticky notes is advantageous, large collections of sticky notes and tear sheets can be difficult to analyze and find common themes. The entire process is also burdensome to collect and record after the session ends.



**Figure 1.** The participant groups sticky notes into themes in a traditional affinity brainstorm session.

Structured brainstorming methods offer variations to these unstructured processes [2]. These methods add formality to these creative processes by electing leaders whose task it is to focus the team on specific concepts or themes, as well as document the process and outcomes. The challenge in these methods is to enable formality where needed, without hindering the creativity and lateral thinking of the team.

In this paper, we present Affinity+ (Figure 2), a large-display brainstorming tool designed to bridge the gap between the unstructured and structured techniques. Affinity+ aims to balance the flexibility of manually creating and position sticky notes with the formality of analytic methods used to calculate themes and clusters of these notes. That is, it provides unobtrusive cues regarding the common themes and clusters at all stages of the process to facilitate discussion regarding emerging topics.

## Approach

We propose that combining known brainstorming techniques with unobtrusive analytics methods creates a semi-structured brainstorming environment. This approach provides context to the ideas generated and visually exposes topics and themes to provide new groupings and directions that may not have been previously considered in the manual process, and ultimately facilitate the process of common ground [3].

Affinity+ is designed to leverage the physicality afforded by large, high-resolution displays [4]. The increased physical space allows users to *physically* navigate to obtain overviews (of other users' processes) by stepping back, and obtain details by moving closer to the display [5]. To enable multiple

users to interact with the display at once, Affinity+ is designed for multi-touch gestures.

### Affinity+ Application



**Figure 2.** Participants using Affinity+ on a large, high-resolution display for a brainstorming session.

#### Description

The application runs on a standard Windows computer and will support and scale to any resolution. However it is recommended that a large, high-resolution display be used to take advantage of higher pixel density for organizing tear sheets and sticky notes collaboratively (Figure 2). Lower resolutions make it difficult to read and cluster objects, as the user must scale the notes to illegible sizes. Standard resolution displays also make group collaboration difficult as only one or two individuals can physically fit in front of them.

User interaction is designed for multi-touch gestures, including rotating, resizing, and relocating sticky notes. These interactions are localized, so that multiple users can interact with the display at once.

Participants contribute sticky notes through mobile devices like smart phones and tablets using SMS,

Twitter, or other proprietary applications. This ability allows users to bring their own devices into the meeting without having to provide additional resources or hardware. In the case of Twitter, the application imports tweets from a predefined hash tag that all participants include in their text.

#### Visualizations and User Interaction

The system is made up of multiple views and corresponding user interactions.



**Figure 3.** A participant uses the radial dial to select ink color for hand-drawn annotations.

All menu actions can be accessed through a context sensitive **radial menu** [6], shown in Figure 3. The dial can be called from a right mouse click or a touch and hold gesture anywhere on the canvas, showing the menu on demand for any user at any location. The menu is hierarchical, similar to many file menus in traditional applications.



**Figure 4.** A participant scales the time dimension of the timeline.

A **timeline** (Figure 4) gives a temporal overview of sticky notes and when they were created. Each note is tagged with the time it was sent and is represented as a yellow square or line on the timeline, squares are notes that haven't been placed on the canvas and lines indicate those that have. The timeline can be panned horizontally to access different time segments, as well as zoomed into and out of to represent less or more time, respectively. Participants can open the sticky note by single clicking or touching it. Once a note is opened the user can drag it up to the brainstorm canvas.

The **brainstorm canvas** allows users to digitally organize sticky notes onto tear sheets in an affinity mapping brainstorm process. Tear sheets contain a title and description, typically representative of a theme or concept of discussion among the group. Users can select and drag sticky notes and tear sheets anywhere on the canvas. They can scale and rotate the sticky notes and even stack the ones that are similar or redundant (Figure 5). Sticky notes can be deleted or "cloned" and put on multiple tear sheets. When sticky

notes are placed onto tear sheets, users can move or resize entire tear sheets, maintaining the sticky notes contained in them. Similarly, when sticky notes are stacked onto each other, they can be interacted with as one object (they can also be un-stacked later).



**Figure 5.** A participant moves and stacks a sticky note on the brainstorm canvas.

Notes and tear sheets can be **annotated** with ink similar to whiteboards through the radial dial. They can choose different ink colors and sizes. The hand-drawn annotation maintains its physical orientation to each object. When a note with ink is moved, the ink moves with it. This maintains the context of the annotation.

A **topic galaxy** (shown in Figure 6) clusters topics provided through the text of the sticky notes extracted using the analysis engine. A text analysis engine provides search and retrieval of data through statistical methods that determine the key topics and themes in the collection. This engine computes similarity within the content of the notes and displays them in a spatial metaphor, as well as labeling key themes. The details are available in [7] (specifically, in the generation of

the "Galaxy View"). As a sticky note is added to the canvas, the topic galaxy adjusts to reflect the addition of new content, showing new clusters and topics for discussion. Each note is represented as a green dot that is then clustered around topics (shown as larger, red dots) extracted from the text of the sticky notes. Then, these topics are given text labels. The users can work between the canvas and the galaxy by selecting notes and comparing where they exist in either view. As an example, a topic extracted by the engine may have notes represented across multiple tear sheets on the brainstorm canvas, and can be highlighted by selecting the topic in the galaxy. This may point out a new topic or show how that topic is related to other topics.

When the brainstorming session is over, the participants can save the current state of the application and access it later. The notes and the structure captured on the canvas are saved as an XML file that can be imported into other applications, like Excel, for analysis or documentation.



**Figure 6.** The topic galaxy clusters notes (shown in green) around system-generated topics and themes (shown in red).

## Discussion

Affinity+ offers a passive form of structure to a traditional unstructured brainstorm process by its ability to analyze and further visualize the text on the sticky notes through its text analysis engine and topic galaxy visualization (Figure 6). The passive nature of these computed brainstorming cues shown in the topic galaxy enables an overview of the current state of the process, and can also bring an emerging topic (or cluster) to the attention of the participants.

### *Operational Use*

The Affinity+ application is currently installed on the MURAL Interactive Power wall at the Computational Sciences Facility at Pacific Northwest National Laboratory. It has been used in brainstorm activities both internally and with clients of the lab.

An early lesson learned from the first pilot was in the use of the contextual radial menu. Users found it cumbersome to walk to a single location for their actions. Making the menu a radial dial localized to the user helped alleviate the issue. However, when multiple dials were invoked at the same time, some of the actions would compete and override each other. For that reason, only one dial can be open at a time. It was observed that users communicate verbally when they use the dial and thus alleviated the conflicting actions and the sudden disappearance of menu when someone else evoked it. These moments of verbal communication, when analyzed, could lead to insights about the collaborative process [8].

Another interesting technical challenge to overcome was the height of our display. A large part of the interaction surface, while touchable, just wasn't

reachable. Users were observed trying to reach items that were over their heads or were physically uncomfortable (or unable) to access. Design decisions were made to make that upper section less interactive and more for summary or ambient information. Additional actions were added to the radial dial to handle a context switch of the upper information with the lower.

#### *Future Work*

The current Affinity+ application is focused primarily on capturing the sticky note brainstorming process digitally with minimal incorporation of many visual analytic tools beyond the topic galaxy. Future work includes adding other visualizations as well as new process algorithms to support additional data relationship mappings. Future work will enable participants to understand how concepts evolved over time, sentiment of a given topic and even measure the coverage of a topic in a brainstorm. Future research will also enable further ubiquitous computing concepts like mirroring the canvas on remote and mobile devices. Instead of having all the participants in one room around a large display, they could collaborate across disparate locations synchronously and asynchronously. These new features will be evaluated by a formal user study.

#### **Conclusion**

In this paper we describe Affinity+, a large display brainstorming application. Affinity+ transforms the traditional sticky note and tear sheet brainstorming process digitally – making it easier to create, organize, and capture ideas regardless of device, group size or location. The real power of the application is that it combines traditional unstructured brainstorming

methods with structured analytic techniques to foster a semi-structured brainstorming environment.

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