Multimodal Interactions: from Supporting to Enhancing Creativity

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Abstract

In this paper, we discuss how different multimodal implementations are not limited to support creativity but go further by enrich it. While sensory feedback can trigger memories and promote novel associations within an immersive context or space, different input methods can foster fluid interactions that allow to explore different paths and solutions smoothly. This work shows the impact of multimodality in Creativity Support Tools and how it should be brought to the future agenda of such tools.

Author Keywords

Multimodal Interactions; Fluid Interactions; Creativity; Creativity Support Tools; Flow

ACM Classification Keywords

H.5.2. Information interfaces and presentation (e.g., HCI): User Interfaces.

Introduction

Humans perceive and interact with the world through different senses and manners [16, 21]. Although this is a natural way for humans to interact with the world, Creativity Support Tools (CSTs) have been mostly based on moving analog information to digital, complemented with key features to explore different and novel ideas, like non-linear editing and diverse

methods of media or data visualization [20]. Thus, current CSTs are still far to promote a multimodal and natural experience, keeping the users in a flow mental state, as defined and stressed by Csikszentmihalyi [7].

Nonetheless, recent research on CSTs have targeted such multimodality in two ways: sensory feedback and fluid interactions for input. While the former aims to trigger memory-based or novel associations while keeping the user focused or relaxed, the latter aims to avoid disruptions in the workflow. In this paper, we present a set of multimodal research applied to CSTs, showing that multimodal interactions can enhance creativity and, therefore, shall be brought to the future agenda of Creativity Support Tools.

Sensory Feedback

All the human senses can be used to spark creativity: from pictorial images [23] or written text [1] to music [17].

Such premise was used in the development of Haven [10], a thematic writing tool that combines a visual background and an equivalent sound. It aimed to avoid the writer's block - a stress reaction that affects their ability to write. Using a minority user group of underserved youths, and by evaluating how they write using different user interfaces, results suggested that such type of tool was capable of conveying a sense of calm and concentration to the users, making them feel better and also write more. Authors also conclude that using Haven, the youths felt more empowered to tell their unique stories and experienced an increase in their mental well-being.

In a more recent work, Gonçalves et al. [12], assessed and compared auditory and olfactory cues while making a creativity task. They found that such combination until a certain level can be inspirational. However, passing a threshold of combination of type of audio and smell it becomes disturbing.

This approach was extended by proposing the design of furniture for improving the wellbeing and creativity levels of practitioners [6]. The multisensorial feedback provided by an interactive workstation (called Sense-seat) brings subtle technological elements and persuades office workers towards adopting healthier and more creative workstyles [6].

A different approach was considered by Gonçalves et al [11] by investigating subliminal priming as a novel technique to support the creativity in writing. Creativity studies have been incorporating story prompts to instigate the creative process in writing. However, such strategies can distract the user from the writing task and impose cognitive overload to get over the writing block. The authors have used a text-editor that provides supraliminal (conscious) and subliminal (unconscious) textual hints during a writing task and studied its impact on user's self-experienced creativity. The results showed that participants in the subliminal condition experienced more loss of self-consciousness when compared to the control condition. Self-report data revealed higher loss of self-consciousness in the subliminal condition while the analysis of eye-tracking data and verbal-accounts revealed a stronger influence on participants' ideas during the supraliminal condition.

A more recent study [13] applied a Virtual Reality immersive environment to creative tasks. It shows that such stimuli can foster the creative potential of each individual, and lead to a greater self-perception of creativity, a "one-illusion interspace".

Fluid interactions

One important aspect of fluid interactions while used in creativity support tools is the ability is to facilitate the switch between the different modalities when they are needed. Such fluid multimodality aims to provide the right tool for a particular task. Although writers like old typewriter interactions, having a free-form of annotating documents is crucial to keep the fluidity enabled by paper [3].

Elmqvist et al [9] discussed fluid interactions in the context of information visualization and characterized them as promoting the flow mental state; supporting direct manipulation [18]; and minimizing the Norman's gulfs of action [15] (Gulf of Evaluation and Gulf of Execution). In their perspective, the basic requirement for fluidity it is the users' feeling of direct participation and embodiment in the interface.

Such behavior was exploited in a multimodal video annotator for contemporary dance, called Creation-Tool [4]. In the Creation-Tool, one can add visual annotations, like digital ink or text, on top of the video content or associate audio with a particular moment in the video. In the user study, the participants preferred to use digital ink and audio for video annotation.

The usage of pen input was extended to the concept of *video as ink* [5], allowing one to paint video content in a canvas and applying a fluid interaction to the complex and hard task of video editing. Such approach to editing allows the exploration of video content in different perspectives and the easy creation of alternative versions. This exploration of different possibilities was highly appreciated by the user study participants.

A different issue was tackle in the ExplorationWall [14], where touch gestures were applied to the exploratory search of information. The interface was designed exploiting touch gestures to promote the formulation and reuse of parallel queries while looking for unknown information (i.e., exploratory search) and reducing the usage of a virtual keyboard, which has been proven to be inefficient and difficult to use [22]. The user study proven that using the ExplorationWall users retrieved more relevant documents, made more parallel queries and were more engaged than doing searches through a regular search interface composed of a query text box and a list of results.

Lessons Learned

From our contributions in these projects we have learned:

Sensory feedback can foster creativity and relaxation while performing creative tasks but depending on the combination and type of modality can overwhelm the user and cause disturbance. Moreover, conscious and unconscious stimuli can influence creativity in different ways. Because emotion, flow and mood play an important role in human creativity, we have to be aware that they can be negatively impacted by improper stimulus. A significant problem faced by interaction designers who are involved in design of Creativity Support Tools is how to integrate the

multisensory stimuli, creating a fully immersive and creative environment and providing the same benefits as natural environments [2, 8], like *Thinking by Free Associations*, one of the creative activities defined by Shneiderman [19]. A balanced sensory feedback can also be used to *shape your space*, one of the Csikszentmihalyi's recommended habits to enhance creativity [8].

Fluid multimodal interactions promote the merge of two creative activities, *Exploring solutions—what-if tools* and *Composing artifacts and performances,* defined by Shneiderman [19]. They allow to reuse the results of exploration of different paths in the composition of a final artifact. Although Shneiderman considers them separately, the combination of these activities is crucial to enhance creativity, as shown by Csikszentmihalyi [8]. Considering problem finding and divergent thinking, Csikszentmihalyi [8] defines a set of mental operations to enhance creativity: finding a way to express what moves you; look at problems from as many viewpoints as possible; figure out the implications of the problem; implement the solution; produce as many ideas as possible; have many different ideas as possible; try to produce unlikely ideas. These mental operations resume the two activities defined Shneiderman [19]. Such behavior can be found when novelists consider different story paths while writing their books; film editors consider different shots while setting up a movie; painters and designers make different sketches and drawings while creating their final piece. The different ideas or solutions, i.e., the results of a what-if analysis, are experimented and can be used for the composition of the final artifact.

Conclusion

In this paper, we discussed and demonstrated how multimodal interactions go further by enhancing creativity. One important aspect of the presented research is that it goes beyond the desktop paradigm. Feedback based on odor and inputs based on pen or touch go further than the traditional human-computer interactions. Future developments on Creativity Support Tools shall integrate these different modalities in a wised manner, promoting a creative environment with the right tools for the task to be performed. Multimodal interactions, through sensory feedback or fluid interactions, are a key factor on going beyond the traditional desktop paradigm in future computing developments and should have an important role in the research agenda of Creativity Support Tools.

Acknowledgements

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