Collaborative Creativity – Sparking Human Creativity in Brainstorming Sessions with an AI Muse

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Abstract

Generative AI has rapidly transformed content creation, but its potential to enhance earlier stages of the creative process, such as brainstorming and ideation, remains underexplored. This paper presents an AI-enhanced brainstorming tool that integrates an AI "muse" to inject novel ideas, or "sparks," into user-generated mind maps. Using a pre-trained model, the AI muse suggests related concepts to inspire the user during ideation. We describe the tool's functionality, the technical implementation of the AI muse, and discuss the challenges of evaluating AI-driven creativity. Our work opens the door to quantifying how AI can enhance human creativity in ideation processes.

1 Introduction

The rapid advancement of generative AI has transformed content creation, with AI tools being widely used for generating text [2], music [3], and images [15]. Beyond content generation, generative AI is increasingly influencing earlier stages of the creative process, such as ideation and brainstorming. Chatbots like ChatGPT are commonly used as sounding boards throughout the creative journey, offering alternative perspectives and enhancing problem-solving.

Brainstorming plays a crucial role in the early stages of creativity by reframing problems and uncovering unexpected solutions. In this paper, we introduce an AI-enhanced brainstorming tool that integrates generative AI into the ideation process. Unlike previous work that focuses on content creation, our tool assists with the conceptualization phase by injecting AI-generated suggestions, or "sparks," into a user-generated mind map.

This extended abstract also aims to explore the potential for quantifying the creative inspiration provided by AI-driven brainstorming tools, raising questions about how AI can support and augment the creative process. The technical overview of our tool is provided in Section 2.

2 A Web-based Brainstorming Tool with AI Muse

We have developed a web-based brainstorming tool that integrates a pre-trained AI model, referred to as the AI muse, to provide additional inspiration during ideation. The tool allows users to build a network of word associations, commonly known as a mind map, with a unique AI-enhanced twist. This section provides an overview of the tool's functionality, the AI muse's role in the process, and a discussion on future possibilities.

The tool starts with an empty central node, which the user fills with a starting word that forms the basis of the brainstorming session. From this central node, the user generates new nodes by adding words they associate with the initial word. Each new node represents a concept the user wants to

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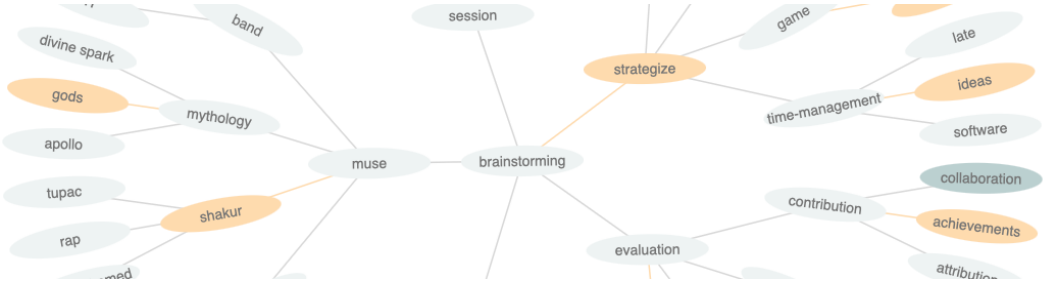

Figure 1: Screenshot from a brainstorming session. The entire network is provided in Figure 2. The gray bubbles contain words that the user has provided while the yellow nodes are sparks provided by the AI Muse. The teal bubble is the node that is currently being filled by the user.

explore further, thereby creating a network that expands outward from the center. In addition to user-generated words, the tool introduces an AI-generated suggestion, referred to as an "AI spark," to inspire new directions for exploration.

The AI sparks are automatically added to the network as child nodes to user-generated words. Each human-generated node receives exactly one AI spark as a child node, which is intended to complement the user's thoughts and provide alternative associations. This ensures that the user's input remains central while also incorporating AI's creative suggestions. The number of sparks could be a tunable parameter in future iterations, but the current design prioritizes simplicity by limiting sparks to one per node. A visual example of this interaction can be seen in Figure 1, where yellow nodes represent AI sparks, gray nodes represent user-provided words, and the teal node is currently being edited by the user. Some implementation details for the AI Muse are provided in Section 3.

3 The AI Muse

The AI muse generates sparks by leveraging a pre-trained model. We experiment with two types of models. One based on word embedddings, specifically GloVe word embedding model [14] and one based on large language models [2]. In the simpler, embedding-based setting, when a user adds a word to the brainstorming session, the AI muse calculates the cosine similarity between the user's word and words in the GloVe embedding space. The tool then selects the third most similar word as the AI spark. This selection is designed to offer a novel yet related concept that can stimulate further ideas without being too obvious. If a user-provided word is not part of the GloVe vocabulary, the AI muse defaults to suggesting "ideas," though future versions will replace this with more contextually relevant suggestions.

For example, as shown in Figure 1, the word "time-management" generates user-provided words like "prioritization" and "scheduling," while the AI muse provides the spark "efficiency." In cases where a word is not in the GloVe vocabulary, as demonstrated on the far right of Figure 1, the tool defaults to "ideas" as a placeholder. This ensures the brainstorming session continues smoothly even when specific words are not recognized.

The alternative implementation based on GPT3 does not suffer from out-of-vocabulary failures. In this implementation of the AI muse, the LLM is prompted with an explanation of the brainstorming tool as well as the word it should create an association for. As in few-shot learning, a few examples of words and their associations are provided with the prompt.

4 Evaluation – Can Inspiration be Quantified?

Prior work in the human-computer interaction (HCI) community has explored the assessment of digital mind mapping tools [13, 11]. However, these studies tend to focus primarily on usability and user experience rather than evaluating the creative outcomes generated during brainstorming sessions. For instance, Beel et al. [4] quantitatively analyzed a large dataset of mind maps, but their findings offer no insight into the quality of the mind maps themselves or the creativity sparked by the process [5, 4].

Mind maps are commonly used in various settings such as classrooms [10, 1, 16, 8], design thinking [12], and executive coaching. However, the evaluation of individual brainstorming sessions remains largely speculative and unscientific. For example, Tony Buzan, the popularizer of mind maps, has claimed that using mind maps allows access to 95% of the brain's potential, compared to only 10% under normal circumstances [9]. While widely read, such claims are not grounded in empirical evidence. In classroom studies, mind maps' efficacy is typically measured by comparing exam scores between students who use mind maps during study sessions and those who do not—providing only an indirect measure of effectiveness.

Quantifying creativity itself is inherently challenging, as creativity often involves generating ideas that are novel, surprising, and useful, criteria proposed by M. Boden [7, 6]. Each of these attributes is subjective and highly contextual, making it difficult to evaluate in a systematic way. An idea that seems novel or surprising in one context may not have the same impact in another, and the usefulness of a creative solution is often contingent on its application.

In our work, we aim to explore whether the inspiration provided by AI can be measured. Below, we outline several potential metrics for evaluating the effectiveness of AI-enhanced brainstorming tools:

User Surveys: Surveys can be conducted to gauge user satisfaction, perceived creativity, and overall effectiveness of the brainstorming tool. Users could be asked to rate how much the AI sparks contributed to their ideation process or whether they encountered ideas they would not have thought of independently.

Educational Outcomes: In settings such as classrooms or workshops, the impact of the AI muse could be measured through learning outcomes. For instance, comparing the quality of work or ideas produced by users who brainstorm with the AI tool versus those who do not may offer insights into its efficacy.

User Engagement: Tracking user behavior within the tool—such as the number of nodes created, time spent brainstorming, and frequency of interactions with AI-generated sparks—could provide a quantifiable measure of user engagement and creativity.

Brainstorming Speed: Another metric could be the speed at which ideas are generated. The time between the creation of user-generated nodes and AI sparks could reveal whether AI enhances the fluidity and pace of ideation.

These metrics could serve as a foundation for assessing how AI influences the ideation process, though a universally accepted method for quantifying creativity remains elusive.

References

[1] Issam Abi-El-Mona and Fouad Adb-El-Khalick. The influence of mind mapping on eighth graders' science achievement. *School Science and mathematics*, 108(7):298–312, 2008.

[2] Josh Achiam, Steven Adler, Sandhini Agarwal, Lama Ahmad, Ilge Akkaya, Florencia Leoni Aleman, Diogo Almeida, Janko Altenschmidt, Sam Altman, Shyamal Anadkat, et al. Gpt-4 technical report. *arXiv preprint arXiv:2303.08774*, 2023.

[3] Andrea Agostinelli, Timo I Denk, Zalán Borsos, Jesse Engel, Mauro Verzetti, Antoine Caillon, Qingqing Huang, Aren Jansen, Adam Roberts, Marco Tagliasacchi, et al. Musiclm: Generating music from text. *arXiv preprint arXiv:2301.11325*, 2023.

[4] Joeran Beel and Stefan Langer. An exploratory analysis of mind maps. In *Proceedings of the 11th ACM symposium on Document engineering*, pages 81–84, 2011.

[5] Jöran Beel, Bela Gipp, and Jan-Olaf Stiller. Information retrieval on mind maps-what could it be good for? In *2009 5th International Conference on Collaborative Computing: Networking, Applications and Worksharing*, pages 1–4. IEEE, 2009.

[6] Margaret A Boden. Creativity and artificial intelligence. *Artificial intelligence*, 103(1-2):347–356, 1998.

[7] Margaret A Boden et al. Dimensions of creativity, 1994.

[8] Anna Buran and Andrey Filyukov. Mind mapping technique in language learning. *Procedia-Social and Behavioral Sciences*, 206:215–218, 2015.

[9] Tony Buzan. *Make the most of your mind*. Simon and Schuster, 1984.

[10] Glennis Edge Cunningham. *Mindmapping: its effects on student achievement in high school biology*. The University of Texas at Austin, 2006.

[11] Haakon Faste and Honray Lin. The untapped promise of digital mind maps. In *Proceedings of the SIGCHI conference on human factors in computing systems*, pages 1017–1026, 2012.

[12] Jeanne Liedtka and Timothy Ogilvie. Ten tools for design thinking. 2010.

[13] Honray Lin and Haakon Faste. Digital mind mapping: innovations for real-time collaborative thinking. In *chi'11 extended abstracts on human factors in computing systems*, pages 2137–2142. 2011.

[14] Jeffrey Pennington, Richard Socher, and Christopher D Manning. Glove: Global vectors for word representation. In *Proceedings of the 2014 conference on empirical methods in natural language processing (EMNLP)*, pages 1532–1543, 2014.

[15] Aditya Ramesh, Mikhail Pavlov, Gabriel Goh, Scott Gray, Chelsea Voss, Alec Radford, Mark Chen, and Ilya Sutskever. Zero-shot text-to-image generation. In *International conference on machine learning*, pages 8821–8831. Pmlr, 2021.

[16] Nebojsa Stankovic, Carisa Besic, Milos Papic, and Veljko Aleksic. The evaluation of using mind maps in teaching. *Technics technologies education management*, 6(2):337–343, 2011.

Appendix A Screenshot of a Brainstorming Session with AI Muse

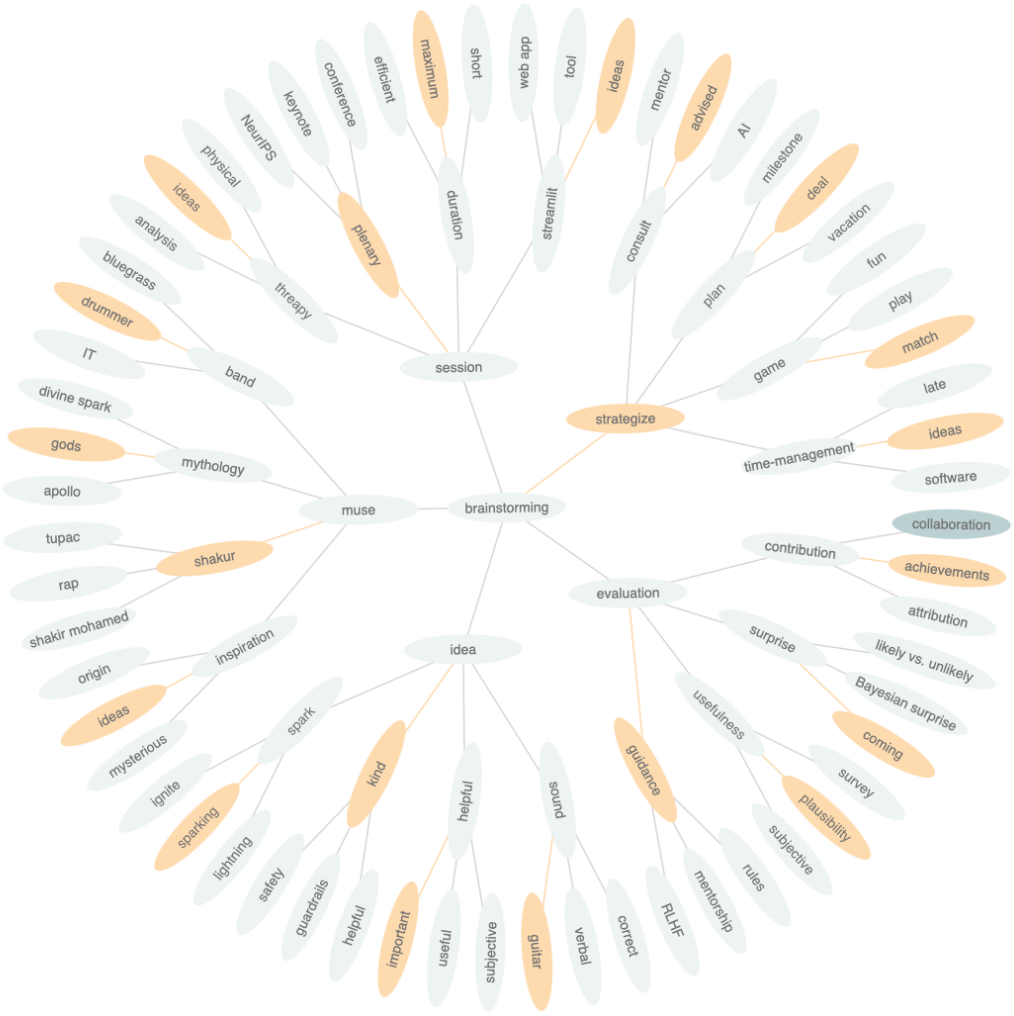

Figure 2: Screenshot from a brainstorming session. The gray bubbles contain words that the user has provided while the yellow nodes are sparks provided by the AI Muse. The teal bubble is the node that is currently being filled by the user.