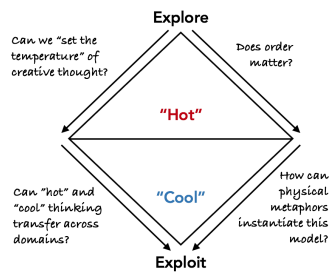

Overcoming Satisficing: Scaffolds for Amplifying Creativity



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Figure 1: My dissertation investigates questions of how to help novices follow the diamond approach of engaging in divergent exploration and convergent exploitation.

Abstract

Creative work combines exploratory thinking to find novel solutions and exploitative thinking to refine those solutions. People often assume that the idea they come up with has to be the “correct solution,” leading to under-exploration and preemptive exploitation. Despite advances in the practitioner literature, a cognitive and empirical basis of exploration strategies remains sparse. My dissertation examines scaffolding methods to enhance exploration in creative tasks. I investigate this through two interventions. First, interactive guidance and adaptive suggestions embodied in the CritiqueKit system to improve evaluation of creative work. Second, problem-framing scaffolds that attune people towards the phases of exploration and exploitation. My research demonstrates content and process scaffolds with applications in the design of creativity support tools and creative education pedagogy.

Author Keywords

creativity; feedback; scaffolds; learning

ACM Classification Keywords

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

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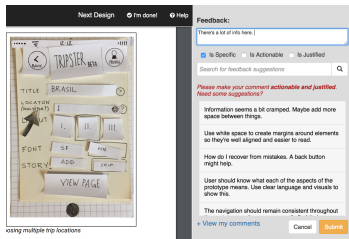


Figure 2: The CritiqueKit interface features 1) interactive guidance of feedback attributes (specific, actionable, and justified), and 2) adaptive examples of previously generated expert feedback.

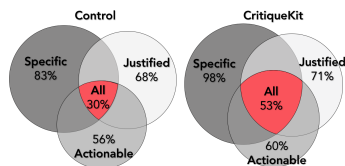


Figure 3: We found in a controlled experiment that participants with interactive guidance and adaptive suggestions provided significantly more Specific, Actionable, and Justified (53%) feedback than participants without these scaffolds (30%).

Creativity as Simulated Annealing

“Hot” & “Cool” Thinking in Creativity

Creative thinking can be viewed as analogous to simulated annealing, starting with an exploratory (“hot”) phase before gradually shifting to an exploitative (“cool”) phase [5]. Unfortunately, effective exploration is difficult because people often *satisfice*, fixating on the first adequate solution they come up with and not wanting to “waste time” on paths unknown [10]. For more structured problems, this strategy works well enough. However, for the complex problems that make up much of creative work, the tendency to satisfice means that potentially better paths are never explored or considered.

Effective exploration comprises of knowing *what* to explore as well as *how* to explore. My dissertation aims to enhance exploration through both content and process scaffolds. My thesis statement is that **more explicitly connecting the process of exploration to exploitation catalyzes creative learning and ideas**. This research aims to contribute to a theoretical understanding of creative learning that supports human-computer synergy.

What Are Existing Methods for Increasing Exploration?

The practitioner literature has made compelling advances towards providing psychological safety nets and structure for exploratory thinking. Process models like the Double Diamond and design thinking strategies seek to encourage wild ideas early. Utilizing examples and iteration to facilitate inspiration and increased quantities of ideas can also encourage more exploration [3, 4]. Despite such explicit prompting and encouragement, novices especially still ideate narrowly.

A challenge of amplifying exploration is giving an appropriate structure for exploration while maintaining the benefits

of unstructured thinking. This thesis addresses this challenge with both content and process scaffolds that attune people towards the stages of exploration and exploitation. I do this in two interventions: heuristic alignment for improving feedback on creative work and problem-framing scaffolds for enhancing awareness of exploratory and exploitative thinking processes in problem-solving.

Interactive Guidance Techniques for Improving Creative Feedback (Completed Work)

A crucial component of learning is receiving feedback for improvement. Giving feedback is itself a creative problem of exploration and exploitation; it requires exploring a piece of work for areas of improvement and then exploiting on relevant features to provide detailed, effective critique [8]. However, novices often do not know what to give feedback on or how to give good feedback.

To help bridge this disconnect, we investigate two scaffolded methods. First, interactive guidance of structural features of effective feedback, and second, adaptive examples of previously generated expert feedback. These scaffolds are embodied in the CritiqueKit system through checkboxes that check whether draft feedback meets three attributes (specific, actionable, and justified) and a suggestions box that displays contextually-relevant examples of good feedback for users to reuse (Figure 2).

Through two classroom deployments and two controlled experiments, we found that participants with the scaffolds of interactive guidance and adaptive suggestions gave more specific, actionable, and justified feedback than participants without these scaffolds (Figure 3)[6]. These findings suggest that adaptive feedback suggestions can attune novices to the relevant features of creative work while interactive guidance can direct people’s attention towards the struc-

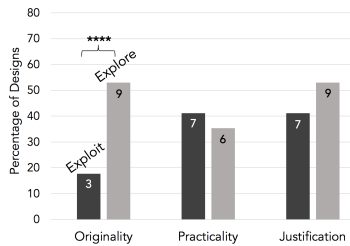


Figure 4: In a controlled experiment, *Explore* designs were significantly more original than *Exploit* designs.

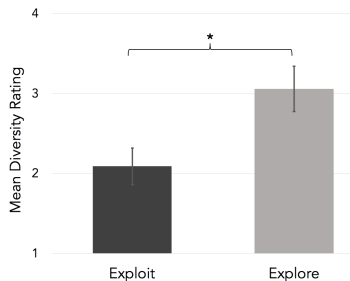


Figure 5: Participants with the *Explore* framing brainstormed more diverse ideas than participants with the *Exploit* framing.

tural characteristics of effective feedback. In addition, our results demonstrate the importance of taking learner context into account for interactive systems to provide more relevant assistance.

Problem-Framing Scaffolds for Improving Exploration (Ongoing & Future Work)

In order to come up with unique and creative ideas, one must first see them. To overcome the strong tendency to exploit too soon, this work investigates several questions of how problem-framing scaffolds can provide people with strategies for productive exploration (Figure 1).

Can We “Set the Temperature” of Creative Thought?

In this study, we examined whether providing scaffolds that frame problems as exploratory or exploitative can influence creative thought. We adapted DeBono’s [2] Thinking Hats as our problem frame scaffolds. In this between-subjects study, 34 participants were recruited from a California research university, half were randomly assigned to the *Explore* frame, the other half to the *Exploit* frame. The task asked participants to redesign an aspect of the student eating experience that could be made more enjoyable.

Designs from the *Explore* scaffold earned significantly higher originality ratings than those from the *Exploit* scaffold (Figure 4). Interestingly, *Explore* participants demonstrated greater intra-exploration as well, brainstorming more diverse ideas than *Exploit* participants (Figure 5). *Explore* participants noted that the explore scaffold challenged or allowed them to think differently while *Exploit* participants mentioned that the exploit scaffold helped organize and structure their thought process. Our findings suggest that simple metaphorical problem frames can attune people towards exploration or exploitation and that the perception or safety of feeling challenged to think differently can bolster

greater creative thought.

Does Order of Exploration & Exploitation Matter?

This experiment will investigate if the order of exploration and exploitation affects creative outcomes. The shift from exploration to exploitation is proposed to be ideal for finding unusual hypotheses [5]. However, exploration may be most fruitful if people are “cognitively ready” for exploration [1].

Similar to the first experiment, participants will redesign an aspect of the student eating experience. In two brainstorming phases, participants will be given either the explore or exploit scaffold, the order of which will be counterbalanced between participants. I hypothesize that an exploration-first ideation process will lead to more original designs than early exploitation. An alternative hypothesis is that scaffolding exploration at any stage in the ideation process will aid creativity regardless of order because of the perceived safety of feeling challenged. These results will provide empirical evidence of how process scaffolds connect with design outcomes.

Can Physical Metaphors of Hot & Cool Thinking Influence Creative Thought?

This study will investigate how physical metaphors of “hot” and “cool” thinking might serve as process scaffolds for creativity. The notions of thinking broadly or narrowly are inherently abstract; metaphorical embodiments of these concepts may make them more concrete. Such metaphors could literally represent temperature such as faucets or thermometers or consist of more subtle analogies to encourage either exploratory or exploitative thinking during creative problem-solving. These results will have practical implications for the design of creativity support tools.

About Me: I am a 4th-year Ph.D candidate in Cognitive Science at UC San Diego. My career goals following my doctoral program include faculty positions in learning sciences departments or information school and industry research positions at companies that focus on creativity support.

Dissertation Trajectory: I have completed one set of studies, which has been published at CHI 2018 (Honorable Mention Award). I am currently working on the final four studies of my dissertation, one of which has been completed. I plan to finish my dissertation work by the end of 2020.

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How Might We Teach Exploratory Thinking Strategies?

A final component of my thesis will examine how problem-framing scaffolds can translate to creative learning. The grand challenge within learning sciences is to find instructional methods that facilitate transfer. Exploratory learning strategies, such as inventive scaffolds, enable learners to explore and invent solutions to problems, often leading to greater problem-solving flexibility and transfer to novel contexts [7, 9]. This experiment will investigate a similar question in open-ended creative work where no distinct solution exists. A potential task might be to provide problem-framing scaffolds and examine creative performance on a subsequent task to demonstrate learning effects.

Current & Expected Contributions

My dissertation investigates both content and process scaffolds to facilitate more productive exploration and exploitation in creative thinking. This research contributes a theoretical perspective on scaffolding creativity and how these scaffolds can be instantiated in software. I hope to influence the design of creativity support tools, pedagogical methods for teaching creative thinking, and innovation practices in professional settings.

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