1. Introduction

Our key research question is, “How can the collaborative engineering design process be made more creative?” Collaborative Creativity research has explored how social interactions influence creativity and recommends creative methods, but does not provide depth into cognitive processes. Creative Cognition research has provided the basis for deeply understanding thought processes and establishing sound design techniques, but ignores collaborative relations. We believe combining these approaches will develop more effective design techniques for stimulating creativity. However, before techniques can be developed, collaborative creative cognition must be explored. Here we specifically explore the idea generating creative mechanism of Analogy and how collaborative stimulation encourages it.

2. Prior Work

The Creative Cognition approach was first established by Finke, Ward, & Smith (1996). They proposed the Genplore model, which cyclically creates new ideas, where Generative Cognitive Processes create ideas and Exploratory Cognitive Processes develop ideas. Benami (2002) took the Genplore model, and modified it for engineering design. He proposed a GSP model for collaborative creativity, where Design Operations generate Design Entities which stimulate Cognitive Processes.

Models of collaborative creativity can be divided into two categories; aggregate models and process models. Aggregate models look at how each team member’s creativity can be combined into the overall group’s creativity (Pirola-Merlo & Mann 2004, Shalley & Perry-Smith 2008). Process models explore the different aspects of collaboration which influence the creative process (Sonnenburg 2004, West 2002).

3. CSED Model and Analogies

Our approach integrates the aggregate and process model views of
collaborative creativity. We extend Benami’s work (2002) to collaboration by proposing a CSED (Collaborative Stimulation in Engineering Design) model. It states that External (Shared) Design Entities stimulates Cognitive Processes through the Collaborative Stimulations (i.e., Seeding, Memory Stimulation, Collaborative Completion, Clarifying and Accommodating). Cognitive Processes can be summed into Creative Mechanisms (i.e., Analogies, Merges and Blends), which produce Creative Ideas.

![Diagram of CSED Model]

**Fig 1. The CSED Model**

We specifically examine the Creative Mechanism of Analogy. An analogy occurs when a source idea is mapped onto a target idea, to bridge a gap (Novick 1988). In creative design, Benami (2002) determined that analogies were made up of the cognitive processes of Memory Retrieval, Association, and Transformation. We propose that the Collaborative Stimulation of these Cognitive Processes will lead to Analogies.

In order to validate the CSED model, and confirm that Collaborative Stimulation leads to Analogies, a design experiment was performed using Retrospective Protocol Analysis, where participants verbalized their thoughts while watching a video of their collaborative actions. This yielded protocols of both the conversation and verbalized thoughts, allowing us to investigate the individuals' cognitive processes.

**References**


This material is based upon work supported by the National Science Foundation under Grant No. 1131422