# BlueSky: Charting entire idea spaces through iterative refinement

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### Abstract

Idea generation platforms have demonstrated the value of diverse crowds for producing product ideas, graphical concepts, and other creative ideas. The positive effects of stimuli and combination of prior examples on the creativity have been established by prior work in design thinking, but too many constraints can also limit the potential diversity of the resulting ideas. We propose a method—implemented in the form of our system, *BlueSky*—that uses iterative refinement to develop a complete map of an idea space. The method follows a cycle consisting of three steps: ideate, map, and complete. This approach aims to help crowds produce a large number of ideas, including "blue sky" ideas. Our system has been implemented, and we are now beginning our evaluation.

## Introduction

Crowd-powered idea generation platforms have shown the potential for leveraging the diversity of online contributors for creative applications such as product development and graphic design. Although commercial services such as Quirky, 99designs, and InnoCentive have resulted in exemplary end results, often benefiting from the interactions between ideators. However, most processes impose little structure on the ideation process, often resulting in many very similar ideas. Furthermore, without a way of knowing whether the idea space has been fully explored, it is difficult to know when to stop the process.

This project follows a vision of a systematic approach that leverages the diversity of the contributors to explore an entire idea space. We are inspired by research in design thinking, which has shown the benefits of visual or textual stimuli (Goldschmidt, Litan Sever, & others, 2009; Goldschmidt & Smolkov, 2006), as well as leveraging previous knowledge (Buxton, 2007; Mumford, Mobley, Reiter-Palmon, Uhlman, & Doares, 1991; Simonton, 2003). Some established approaches use multiple examples (Yu & Nickerson, 2011), and combine novel features of the given designs from the previous generations (Yu & Sakamoto, 2011).



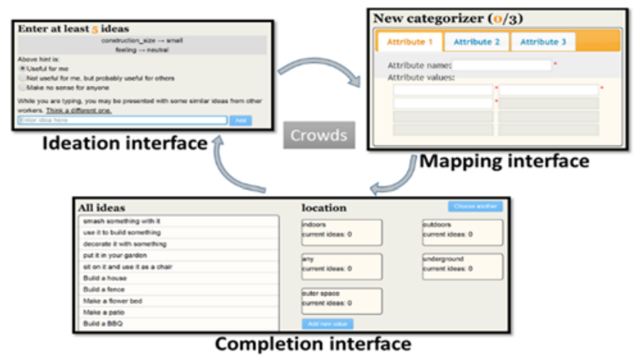


*Figure 2: Schematic of BlueSky System*

Our approach—and the implementation, called *BlueSky*—maps out a design space into an ontology of all possible ideas. Given a brief prompt provided by a requester, it can coordinate workers to generate a set of textual ideas that uniformly covers the entire idea space.

This method consists of a 3-part cycle:

1) **ideate** – Workers enter ideas, sometimes with "hints" in the form of constraints.
2) **map** – Workers determine appropriate dimensions with which the ideas could be categorized. For each dimension, they provide a set of values that completely and uniformly covers the dimension (e.g., red, green, blue, black, and white for colors).
3) **complete** – Workers categorize the ideas from the "ideate" step according to the dimensions from the "map" step, resulting in a map of the ideas so far, and automatic identification of all remaining holes (areas in the design space that have not been covered by any ideas).

The process repeats from step 1 until the map is full (complete coverage of the design space), or until the requester is satisfied.

The key innovation of this method is its ability to produce a map to detect congested space and allocate evenly the crowdsourcing resources, resulting in a reduction of duplicates. The system takes inputs from requester, such as brief requirements and goals, and outputs a list of innovative ideas that uniformly cover all the spaces on the map.

## Description of System

BlueSky is an innovation platform that supports massive online brainstorming session. Figure 1 depicts the three main steps in the interaction: *ideation* (top left), *mapping* (top right), *completion* (bottom). Correspondingly, we refer to the three groups of workers as *ideators*, *mappers*, and *completers*, respectively. In addition to these worker interfaces, BlueSky also includes a dashboard to allow the requester to monitor the process, and prune dimensions or branches of the idea space that are not desired.

In the first step of the 3-part cycle, ideators input a set of ideas. In the first iteration, no stimuli are given, so ideators can input ideas freely, just following the informal requirements from requester. In subsequent phases, ideators will be prompted with "hints" (stimuli) based on the results of the completion interface.

The mapping interface will launch when the number of ideas reaches the threshold. At that time, the ideation pauses. Mappers categorize and extract distinct dimensions from these ideas. Further, they divide each dimension into several uniform sub-dimensions to cover all the existing ideas. Mappers are working in parallel but blind to each other. The next group of mappers can choose to either modify existing dimensions or input new ones. Dimensions evolve until the system can infer from the workers' contributions that a few of the dimensions are broadly applicable and agreed upon by the workers in the map phase. The dimensions are then pushed to the completion interface, along with all the ideas.

Based on the rough map, completers identify which sub-dimensions each idea belongs to. The sub-dimensions not filled with ideas are regarded as holes, which are exploited to generate the stimuli for ideators. Ideation resumes if there are holes on the map or the requester is not satisfied.

In terms of dashboard page, the requester is able to see the whole picture of the map, including the progress in each dimension. They can also view a list of ideas are filled in one dimension or the combination of multiple dimensions. Moreover, the requester has the ability to prune dimensions that appear unlikely to generate useful or genuinely distinct ideas. Through this process, the requester obtains an increasingly explicit map of the design space while refining the requirements given to workers.

## Plans for Evaluation

BlueSky has been implemented and we are now preparing to conduct an evaluation to measure the effectiveness of this method. The evaluation will seek to answer the following research questions:

- Do coverage holes in the design space lead to useful ideas that would not have otherwise been found (or low value ideas)?
- Will the dimensions generated by workers be orthogonal (such that combining dimensions leads to distinct ideas)?
- By generating stimuli from the categorization of prior ideas, will the creative process mimic the synergistic found in traditional brainstorming.

## Summary

BlueSky is designed to work in massive sessions. The critical challenge is to control the size of the whole space otherwise explosion of ideas might occur. We are also exploring how to best evaluate our system given a number of ideas in the end. We believe BlueSky has great potentials in supporting massive brainstorming.

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