

The effects of time and incubation on design concept generation



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The optimal length and format for concept generation is largely unknown. One experiment compares a 50-min session to a 2-h session, observing that senior undergraduates generate more ideas and a greater variety of solutions with additional time, although high novelty solutions are developed within the first 50 min. A second study finds that more novel solutions are generated after an incubation period, although it is at the expense of feasibility. Comparing the two studies shows that incubation generates a greater quantity of ideas, while extended time aids in high quality and novelty. Since the 50-min and 2-h groups generate similar numbers of high quality and high novelty solutions, a 50-min ideation period is effective for developing high quality, novel solutions.

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Design often begins with a concept generation period to develop solutions to a known problem. Designers benefit from exploring a great quantity and variety of potential solutions before choosing a design that best fits their requirements. To develop a good solution base, designers need to thoroughly explore a solution space during the idea generation period. However, the necessary format and length of the idea generation period is largely unknown (Shah, Smith, Vargas-Hernandez, Gerkens, & Wulan, 2003). For studies on design methods, experiments often give a participant 20 min to an hour to generate solutions in attempts to mimic the concept generation process; however, this may not be the ideal amount of time for an engineering design experiment. Designers may need more time in order to discover the solutions that are not easily accessible or to find analogies from distant domains.

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designer stops consciously working on the design problem for a certain amount of time. The effects of including an incubation period in the concept generation process have been found in some research (e.g. Beck, 1979; Segal, 2004; Shah, Smith, & Vargas-Hernandez, 2003; Sio & Ormerod, 2009), which includes the reduction of fixation in certain cases (Kohn & Smith, 2009). However, the causes behind these effects are not well understood, and there is no standard by which incubation is conducted (Dodds, Ward, & Smith, 2004).

This paper describes two controlled experiments which were conducted using novice engineers enrolled in a capstone design course. It examines the effects of varying concept generation period lengths as well as the effects of including an incubation period in the design process for a single design problem. The first study compares a 50-min idea generation period to a 2-h period in order to determine the effects of additional time on the quantity of non-redundant generated ideas, the quality of the solutions, and the expansion and exploration of the solution space. The second experiment was performed to examine the effects of a long incubation period and its relationship to design fixation. In this second study, participants were given an example solution to a specified design problem in order to induce fixation. They were then given 50 min to generate solution ideas, after which they had two days of incubation before being given fifty more minutes to continue generating solution ideas for the same design problem. The results from this second experiment were evaluated using the same metrics as the first study, as well as a specific metric aimed at evaluating fixation effects. This paper also includes a comparison of the effects of giving designers an extended initial period for concept generation as opposed to implementing an incubation period during this process. These experiments allow us to look into the creative design process as it relates to time.

1 Background

A broad review of literature concerning design experiments and incubation studies was conducted in order to better understand how both the length of time spent and the implementation of incubation periods may affect the concept generation process. An overview of this related literature is presented in this section to aid the reader in understanding the hypotheses and results of the studies conducted in this paper.

1.1 Time effect

Research studies on concept generation usually include an idea generation period lasting between twenty and 60 min (Liikkanen, Björklund, Hämäläinen, & Koskinen, 2009). This short time period is often used in university settings because it is easier to recruit volunteers and fits within a class period so students can participate in class or between classes. However, it is uncertain if that time period is a good balance between the time a subject is willing to give and the productivity of the concept generation period. Ideally,

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