
Sketch or Play? LEGO[®] Stimulates Divergent Thinking for Non-sketchers in HCI Conceptual Ideation

Annemarie Lesage
Hubert-David Au-Yeung
Tech³Lab, HEC-Montreal,
Montréal, Québec, Canada
annemarie.lesage@hec.ca
hubert-david.au-yeung@hec.ca

Simon Bourdreau
ESG-UQÀM
Montréal, Québec, Canada
bourdreau.simon.2@uqam.ca

Béatrice C. Caron
Tech³Lab, HEC-Montreal,
Montréal, Québec, Canada
beatrice.caron@hec.ca

Pierre-Majorique Léger
IT Department, Tech³Lab, HEC-Montreal,
Montréal, Québec, Canada
pierre-majorique.leger@hec.ca

ABSTRACT

Sketching is known to support divergent thinking during conceptual ideation. Yet, in HCI teams, non-designers are known to be reluctant to sketch. Looking for a tool that could support non-designers' divergent thinking to creatively offset familiar solutions while providing starter suggestions, we hypothesized that LEGO pieces could replace sketching. In a comparative lab experiment, 36 participants did two conceptual ideations of Web interfaces, one using paper/pen, the other LEGO, in random sequence. The 72 resulting interfaces were assessed on their fluency, flexibility, elaboration and originality according to Guilford [6] and Torrance's [9] divergent thinking framework. Our main finding is that LEGO could substitute sketching for non-designers; the 3D figurative, constructive pieces provide a stimulating visual representation that supports

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

CHI'19 Extended Abstracts, May 4-9, 2019, Glasgow, Scotland, UK.

© 2019 Copyright is held by the owner/author(s).

ACM ISBN 978-1-4503-5971-9/19/05.

DOI: <https://doi.org/10.1145/3290607.3313023>

KEYWORDS

Creativity support; design methods; visual design; lab study

CCS CONCEPTS

User interface design; HCI; Tools for interaction design.

divergent thinking by offering alternate meanings, generating greater number of elements to react to, thus enhancing the use of analogies.

INTRODUCTION

When was the last time you picked up a pen and nailed a budding idea by sketching it? HCI and design literature have long recognized freehand sketching as the best support for ideation, since many qualities in sketching are useful to conceptual ideation, i.e. the moment when new ideas emerge; members of the design team link not-yet-fully-formed mental images to visual representations in a continuous interaction to share and expand on each other's ideas [e.g. 5]. During that moment, sketching allows the HCI team to communicate imprecise, uncertain and provisional ideas without prematurely committing to a decision [5].

HCI's reliance on sketching for ideation does, however, contain an inherent weakness, namely that many people – non-designers as well as design novices – are reluctant to sketch [2]. This becomes an issue in design thinking because non-designers are often dominant in such activities. To deliver innovative results, the design thinking process needs to involve iterative sequences of divergent and convergent thinking [3]. The convergent thinking process leads to a single best answer [3], whereas divergent thinking brings in innovation as it “*involves producing multiple or alternative answers, [...] transforming information into unexpected forms*” [3, p.391]. Sketch as a tool could support both processes, but the ambiguous nature of the conceptual sketch often suggests new and unforeseen proposals. Converging too fast will restrain creativity. With too little divergence, design thinking runs the risk of turning in a linear process, thus losing its creative potency.

For this study, we have considered the need for tools that support divergent thinking; tools, which can handle imprecise, uncertain and provisional ideas while sidestepping the reluctance that sketching can provoke in non-designers. The right tool would ideally slightly offset design-thinking participants' tendency to hone down on a solution too fast (convergent thinking process), inspiring them instead to look at their design problem differently in order to stimulate innovative divergent thinking processes. LEGO pieces were chosen as an experimental stimulus after carefully considering using clay, PLAYMOBIL® figurines, decks of images, and more. We also decided against using standard 2D web prototyping tools because they don't actively stimulate divergent thinking, lacking the ambiguity of sketching or the propositional abilities of parametric design software. LEGO combines qualities that we hypothesize could outmatch sketch in ideation: it is a constructionist system that affords abstract (i.e. undetermined) and figurative (i.e. determined) pieces—one can start from nil or from figurative suggestions; it's a 3D system that requires physically handling the pieces—bringing different cognitive dimensions into play. Moreover, because we wanted to assess the impact of the tools themselves (pen/paper and LEGO pieces), we decided against the LEGO Serious Play framework, since much of its creativity lies in its guided collaboration. LEGO pieces have a malleable figurative and abstract nature, which can trigger metaphors or analogies [e.g. 4], which play a fundamental role in divergent thinking.

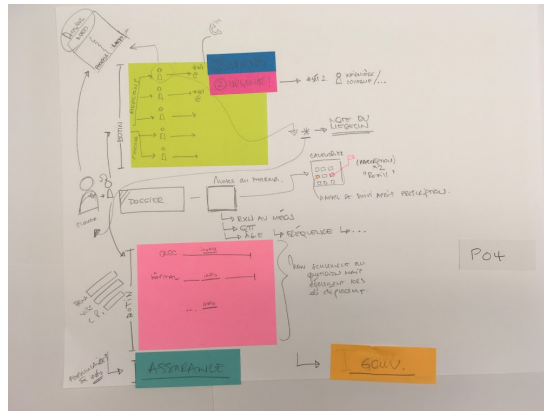


Figure 1: Example of a paper and pen interface proposal

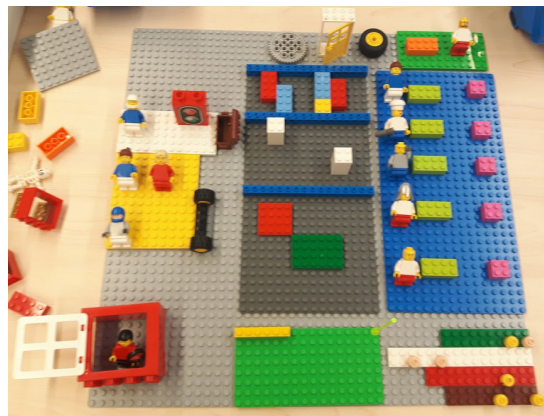


Figure 2: Example of a LEGO interface proposal

This led us to our central question: How does using LEGO compare to using pen/paper during the HCI conceptual ideation phase for non-designers? Our goal was to examine the effects of LEGO on conceptual ideation, and to see if it could be a substitute to sketching in such ideation.

For this study, we conducted a comparative lab experiment between paper and pens (typical sketching material) and LEGO pieces. Participants had to individually do the initial ideation for two web interfaces. We were looking for creative, divergent interface proposals. We purposely selected (3D) LEGO to do 2D interfaces to challenge participants to get out of their comfort zone, step back and get a new perspective, while inducing playfulness (several studies identify play as a trigger of divergent thinking [e.g. 1]).

METHODOLOGY

This lab experiment involved two factors, medium (LEGO vs. pen/paper) and sequence (the order in which they were used); examples of both interfaces in Figures 1-2.

Hypotheses

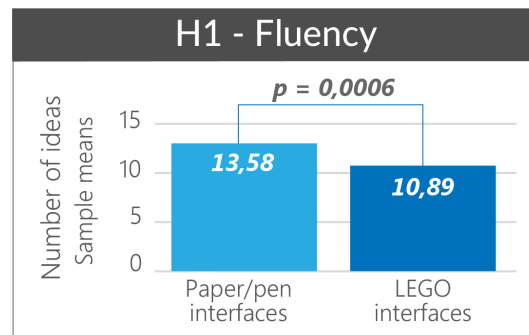
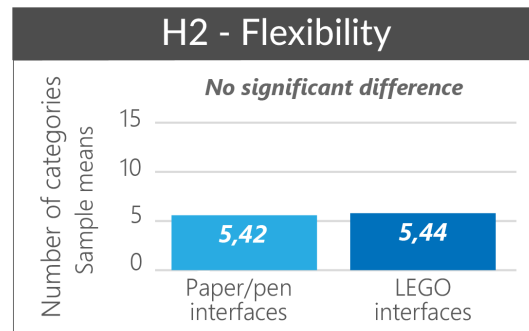
Based on the combined frameworks of Guilford [6] and Torrance [9] for divergent thinking, we tested four hypotheses: In a comparison between Paper/pen and LEGO, during HCI conceptual ideation, the use of LEGO will generate a larger number of ideas [6] (**H1-fluency**) and categories of ideas [6] (**H2- flexibility**), greater elaboration [9], i.e. greater amount of details measured in terms of the number of elements in an interface proposal, than the use of pen/paper (**H3-elaboration**) (for example, a smiley face with two eyes, a smile, the contour of a head with a scribble for hair has 4 elements, the two eyes counting as one element since the Torrance test advises a single count for repeated items); as well as greater originality [6] than the use of pen/paper (**H4-originality**). For each hypothesis, we paid attention to the sequence of tool use, if any condition conveyed better results.

Data treatment and analysis

To measure H1/H2/H3, fluency, flexibility and elaboration, 2 research assistants respectively counted the number of ideas (fluency), categories (flexibility) and elements (elaboration) generated by each interface proposal, cross-referencing video recordings, verbatim transcripts of the interviews, and the photos taken of the interfaces. The two research assistants compared and debated their results until they agreed on a definite number for each hypothesis. The level of originality of each interface was assessed through Silvia's subjective scoring method [8]. To determine the originality, three experienced web-designers individually judged the ideas of each interface. They were instructed to consider uniqueness (uncommon and pertinent), remoteness (how far from the obvious) and cleverness (insightful visual and verbal communication of their idea), and rate them on a scale of 1 (poor) to 5 (strong). The 72 interfaces yielded 881 ideas, so the three experts provided 7929 ratings; the mean score of each idea was used for analysis. Data

Table 1: The 4 conditions of tool use

	1st ideation/ Persona 1	2nd ideation/ Persona 2
Condition 1	Paper/pen	Paper/pen
Condition 2	Paper/pen	LEGO
Condition 3	LEGO	Paper/pen
Condition 4	LEGO	LEGO

**Figure 3: Results for H1-Fluency****Figure 4: Results for H2-Flexibility**

analysis was conducted by means of SAS software, using a linear regression with mixed model, and a 2-tailed p-value.

Experimental design and protocol

Participants (N=36; F=18, M=18) were 20-46 of age, with median age of 24 y.o. 24 were university students and 12 panel members (from outside university). One was a designer and a sketcher, 35 were non-designers and non-sketchers. Each participant completed two conceptual ideations for a healthcare-related interface for a specific persona, which was presented through a 2-min video (Persona 1: an aging woman caring for her cancer-patient husband; Persona 2: a pharmacist).

First, Participants were asked to do a **4-min creative warm-up exercise**; then, **two 14-min ideation sessions** using pen/paper (different sizes & colours sticky notes, felt-tip & lead pens) and/or LEGO (various sizes/shapes of Duplo®, regular LEGO, plates, mechanical & architectural pieces, as well as mini-figures). Participants were randomly assigned one of four conditions for their ideations (as per Table 1).

There were **3 semi-structured interviews**: two post-task and one final one. In the post-task interviews, they were asked to describe their interface design. This oral description was considered an integral part of their proposal. In the final interview, participants were also asked to compare the impact of the given tool on their interface design proposals.

RESULTS AND DISCUSSION

Our results do not support H1 (Figure 3): interfaces made with pen/paper yielded a significantly higher number of ideas than LEGO ones ($p=0.0006$). A number of participants expressed the difference between their processes with pen/paper and LEGO in terms of a dichotomy where paper was associated with efficiency, ease of “not thinking”, just writing, while LEGO was associated with strenuous, fun and creative thinking (e.g. “*It was more fun [using LEGO] to try to think instead of just writing on a bit of paper*”—Participant 27; “*To be efficient, a pen is better. To be creative, LEGO are more visual*”—Participant 34). These observations may explain why paper/pen generated higher number of ideas (H1); this appears to be linked to with the ease of verbal ideation (words written on sticky-notes). Interestingly, H2 assessment of flexibility through the number of categories was not supported by our results, as no significant differences were found (Figure 4). This suggests that if paper ideas may be faster to generate, their greater number does not imply greater divergence.

Our results do support H3, i.e. assessment of elaboration through the count of superfluous elements, as the LEGO interfaces generated a significantly higher number of elements than those made with pen/paper ($p=0.0011$) (Figure 5). Torrance’s rationale behind the notion of elaboration is that the more elements, the more likely the next ideation iteration will diverge away from the obvious. In this study, the figurative LEGO pieces have been said to trigger ideas (e.g. “*every piece that’s not a brick, is a source of inspiration*”—Participant 6). Furthermore, assessment of the order of tool-use (Figure 6) showed that the LEGO-paper sequence (condition 3) generated a significantly higher count of elements than paper-paper (condition 1) ($p=0,0753$). This and the invalidated H2

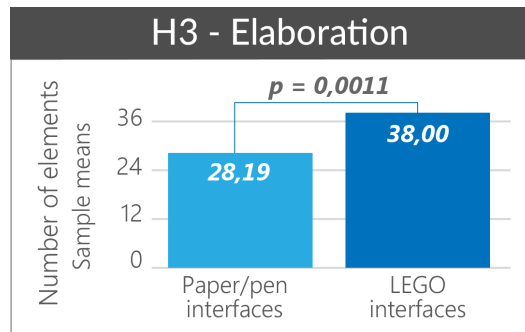


Figure 5: Results for H3-Elaboration

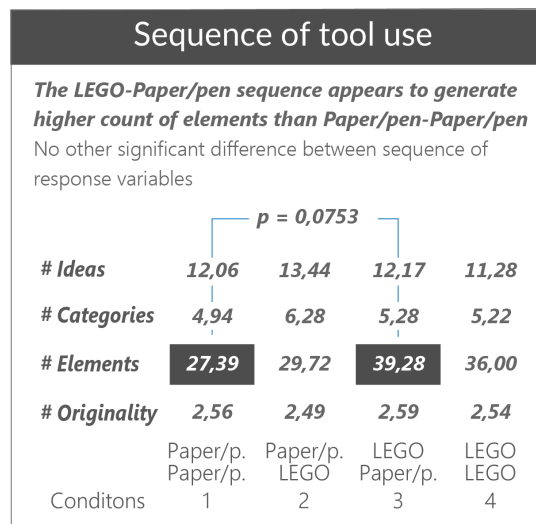


Figure 6: Results of sequence of tool use

(no significant flexibility difference between tools) support the idea that LEGO is associated with divergent thinking and pen/paper (particularly when relying on words jot down on paper) is best used to converge; when used in both ideations, paper/pen delivers the least amount of elaborations, appearing to shrink the breadth of alternative meanings.

H4, the assessment of originality, was not supported, as no significant differences were found between tools (Figure 7). This raises a few questions: Could it be that the greater number of paper/pen ideas counterbalanced the originality of the fewer LEGO ideas? Or could the sample mean of about 2.5 on a 5-point scale, for both paper/pen and LEGO, be hiding a more complex (i.e. split) distribution? In the latter scenario, one possible interpretation might be linked to the Torrance framework itself, which, has been discussed as covering at least two dimensions of creativity at once: innovation and adaptation [7]. Innovators tend to gravitate toward creativity that is original, transformational, and expressive, whereas adaptors are linked to creative endeavours that are logical, adequate, and well crafted. Based on what the participants told us (some were clearly frustrated by having to use LEGO), it is possible that our sample was composed of these two profiles; the adaptors, finding LEGO to be more challenging, may have lowered the mean originality score to 2.5. We are currently doing more analyses to see if there are multiple profiles within the sampling that could justify the 2.5 / 5 sample means with either tool.

In this study we deliberately isolated a 2D word-based ideation tool from a 3D figurative tool to provoke participants to creatively engage with each one, to assess their individual impact on the quality of ideation. LEGO-reluctant participants repeatedly told us that the absence of written/textual communication options with LEGO limited their ideation process. This underscores the importance of being able to write words—pen/paper are traditionally used for both sketching and jotting down notes. As we focus on moving the benefits of sketching to another media, the LEGO-reluctant participants remind us of the importance of retaining the ability to write indications. This being said what appears to be at work here is not so much a written (i.e. textual/verbal) to visual media dichotomy, but an appreciation of written media for *quick and precise notation* combined with a choice of (playful) *figurative suggestions* to jump-start the divergent thinking process. Our results suggest that for this tool combination to deliver best performances, design thinking participants would first work mostly with the 3D figurative constructive tool, to “prime” divergent thinking. They will benefit from the evocative metaphors these provide, suggesting a greater array of alternate meanings, leading to more elaborate narratives. Then, once ideation has opened to novel (divergent) ideas, textual means can take a more dominant role in ideation, writing/jotting down words rapidly to produce a greater number of ideas. Limiting the sequence of tools to text-centred paper/pen seems to lower the divergence, and in turn, the ideation performance.

Going back to our research question, we propose that non-sketchers could use LEGO as a substitute to sketching to induce innovative divergent visual representations for HCI interfaces. The main contribution of this paper is that a 3D figurative constructive tool appears to stimulate divergent thinking because it supports a larger range of elaborations deviating from the initial proposal, even though it may not produce the largest quantity of ideas.

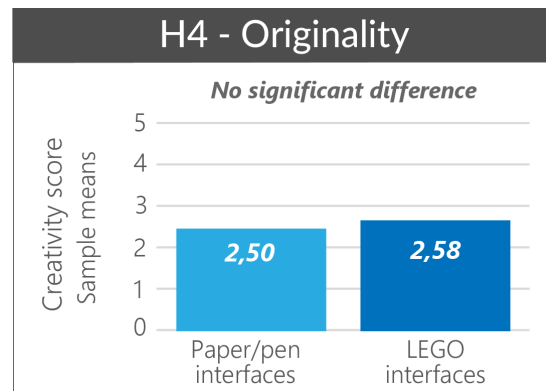


Figure 7: Results for H4-Originality

ACKNOWLEDGEMENT

We would like to thank the NSERC-Prompt Industrial Research Chair in User Experience for their financial support, Tech³Lab staff for their invaluable help as well as the participants for their generous input, patience and playfulness.

FUTURE WORK

We have presented here the first phase of an on-going research. Hypotheses 1 (number of ideas) and 4 (number of elements) have been answered in significant ways; hypothesis 2 (number of categories of ideas) was infirmed and still provided interesting information, namely that there are no significant differences in the number of categories of ideas produced by paper/pen or LEGO ideations. As it stands, and as noted previously, the results for the evaluation of originality raise questions. We are pursuing further analyses moving away from using the sample means looking into possible clustering of the sample to better interpret the originality data. Relying on sample means does not acknowledge the fact that some participants were LEGO-reluctant, some revealed themselves to be LEGO enthusiasts, and a fair number did not express either view (particularly those who experienced condition 1, i.e. paper/pen-paper/pen).

Now that we have a better idea of the impact of these two tools as well as of the needs and mental schema of design thinking participants as they launch into a first iteration of a web interface, the next phase of this research on tools that could replace sketching will be to reproduce this experiment in a collaborative setting. Our goal is to see what happens in a more dynamic and iterative exchange, when concepts are developed in a dialogical setting, progressing quickly as participants add to each other's ideas.

REFERENCES

- [1] P. Bateson. 2015. Playfulness and Creativity. *Current Biology* 25, 1, R12-R16.
- [2] J. W. Booth, E.A. Taborda, K. Ramani, and T. Reid. 2016. Interventions for teaching sketching skills and reducing inhibition for novice engineering designers. *Design studies*, 43, 1-23
- [3] A. Cropley. 2006. In Praise of Convergent Thinking. *Creativity Research Journal* 18, 3, 391–404.
- [4] D. Gauntlett. 2007. *Creative Exploration - New Approaches to Identities and Audiences*. New York, NY: Routledge.
- [5] G. Goldschmidt. 2017. Manual Sketching: Why Is It Still Relevant? In *The Active Image*. Springer, Cham, 77-97.
- [6] J. P. Guilford. 1959. Three faces of intellect. *American Psychologist* 14, 8, 469-479. DOI: <http://dx.doi.org/10.1037/h0046827>
- [7] K. Hee Kim. 2006. Is creativity unidimensional or multidimensional? Analyses of the Torrance Tests of Creative Thinking. *Creativity Research Journal* 18, 3, 251-259.
- [8] Paul J. Silva, Emily C. Nusbaum, and Roger E. Beaty. 2017. Old or new? Evaluating the old/new scoring method for divergent thinking tasks. *The Journal of Creative Behavior* 51, 3, 216-224.
- [9] P.E. Torrance. 1974. Verbal Tests, Forms A and B" and "Figural Tests, Forms A and B. In *The Torrance Tests of Creative Thinking: Norms, Technical Manual Research* ed. Princeton, NJ: Personnel Press.