

Interventions for Ideation

Impact of framing, teaming, and tools on high school students' design fixation

Eli M. Silk & Shanna R. Daly
University of Michigan

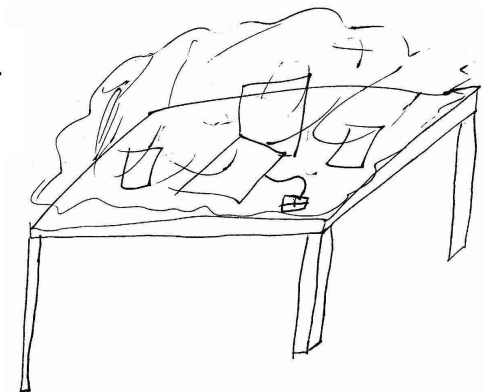
Kathryn W. Jablokow
Penn State University

Seda Yilmaz & Meisha Rosenberg
Iowa State University

7 April 2014
AERA, Philadelphia, PA



put an invisibility
blanket on the
table.



Idea generation is the process of generating alternative ideas to solve a design problem

Crismond & Adams (2012)

IDEA SCARCITY

vs.

IDEA FLUENCY

Start design work with a few or just one idea

vs.

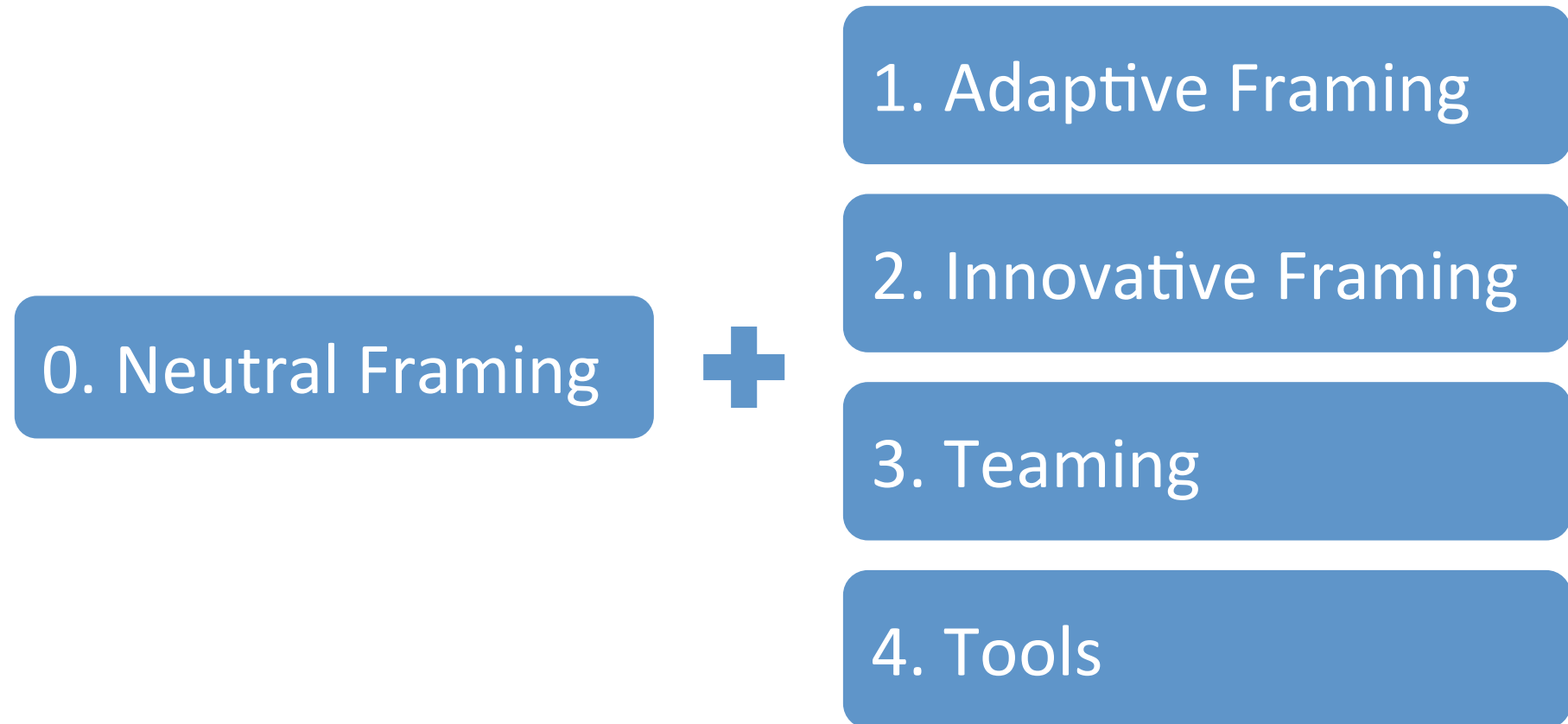
Start design work with an abundance of ideas

Reluctance to discard, add to, or revise the initial idea(s)

vs.

Utilize techniques to explore the design space and avoid fixation

Test 4 ideation interventions



Intervention #1 = Adaptive Framing

Work within constraints and generate practical ideas

Low-Skill Snow Transporter

Jin & Chusilp (2006)

Neutral Framing

Design a way for individuals without lots of skill and experience skiing or snowboarding to transport themselves on snow.



Adaptive Framing

Your solutions should focus on improving existing designs or adapting familiar ways of approaching the problem or similar problems. Consider constraints such as weight and size in your solutions, so users could carry it and be able to bring it with them in their car. Also think about how the solution is powered given that it should make it easier for people to go up hill as well as downhill, but should also be reasonably affordable.

Intervention #2 = Innovative Framing

Loosen constraints and generate radical ideas

Low-Skill Snow Transporter

Jin & Chusilp (2006)

Neutral Framing

Design a way for individuals without lots of skill and experience skiing or snowboarding to transport themselves on snow.

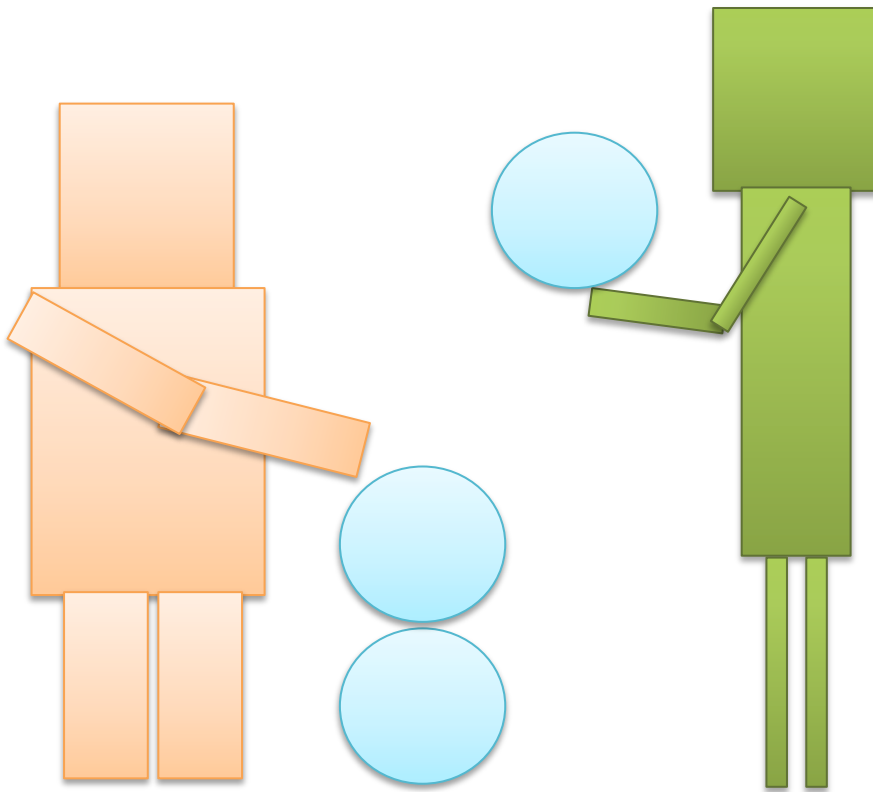


Innovative Framing

Your solutions should focus on creating totally new designs or developing totally new ways of approaching the problem. Don't be concerned about a particular size or weight of your solution, and feel free to choose any materials you desire, as those sorts of constraints might be able to be worked out in the future.

Intervention #3 = Teaming

Work with a partner to generate ideas



Attending to another person's ideas may help an individual see another perspective or way of approaching a problem that they would not have considered otherwise.

Intervention #4 = Tools

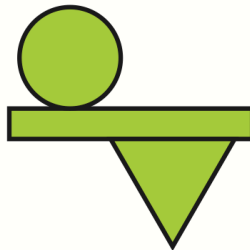
Use Design Heuristic cards to explore design space

title introducing heuristic

Daly et al. (2012)

UTILIZE OPPOSITE SURFACE

76



Create a distinction between exterior and interior, front and back, or bottom and top. Make use of both surfaces for complementary or different functions. This can increase efficiency in the use of surfaces and materials, or facilitate a new way to achieve a function.

© Design Heuristics,

UTILIZE OPPOSITE SURFACE

76



980 TATOU

Annika Luber

The laces wrap around the bottom of this shoe and connect with the sole.

FARALLON CHAIR

fuseproject

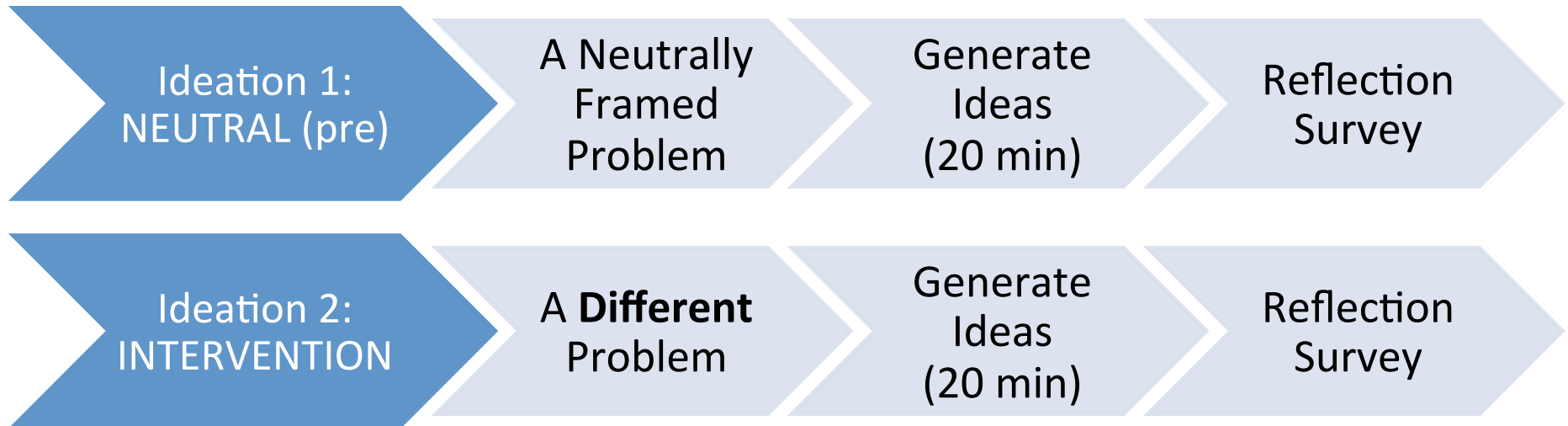
The back side of this chair has a pocket for storage.



explanation of heuristic

examples that use the heuristic

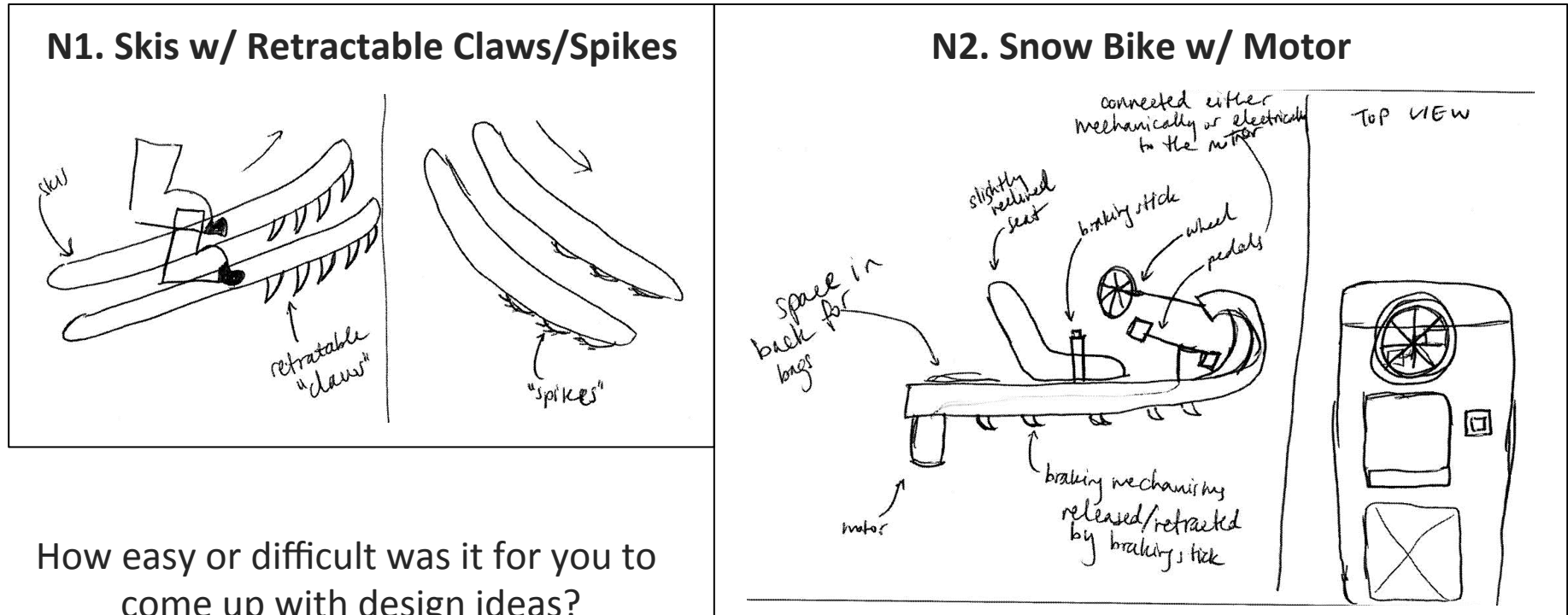
Our research design has high school prospective engineers generate ideas in two different ideations



1. Do the interventions impact the quantity of ideas participants generate?
2. Do participants perceive the interventions as making ideation less difficult?

Let's consider a case example... Alice

Neutral Ideation (*Low Skill Snow Transporter*)



How easy or difficult was it for you to come up with design ideas?

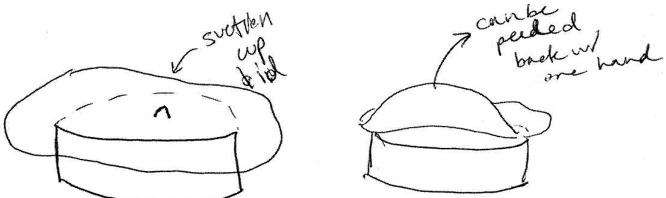
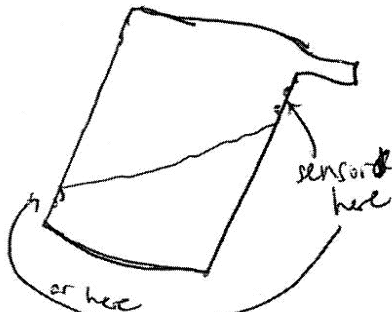
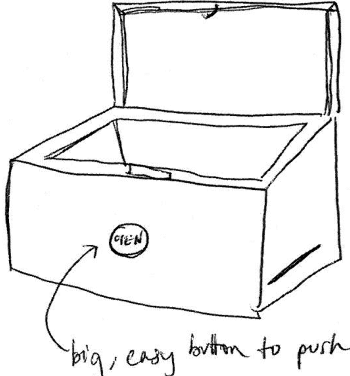
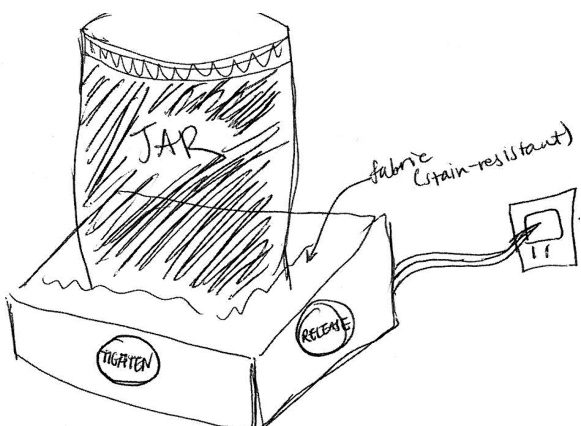
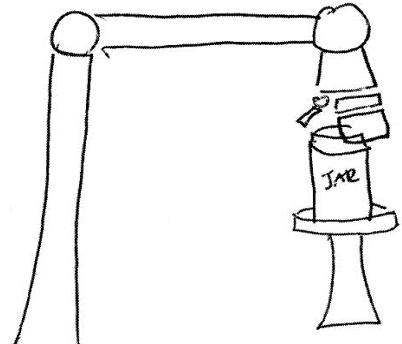
1 ... 2 ... 3 ... **4** ... 5 ... 6 ... 7
Very Difficult Neutral Very Easy

“It was difficult to come up with good ideas, but thinking of ideas wasn’t too hard.”

The intervention helps Alice consider more ideas

Lemons et al. (2010)

Tools Intervention Ideation (*One-Hand Opener for Lidded Food Containers*)

<p>I1. Suction Cup Lid</p>  <p><i>Add to existing product</i></p>	<p>I2. Jug w/ Sensor</p>  <p><i>Adjust function through movement</i></p>	<p>I3. Easy Button Box</p>  <p><i>Fold</i></p>
<p>I4. Tighten Around Base</p>  <p><i>Mimic natural mechanisms</i></p>	<p>I5. Robotic Arm</p>  <p><i>Mimic natural mechanisms</i></p>	<p>2 ideas ➔ 5 ideas</p>

The intervention helps Alice consider more ideas

Tools Intervention Ideation *(One-Hand Opener for Lidded Food Containers)*

How easy or difficult was it for you to come up with design ideas?

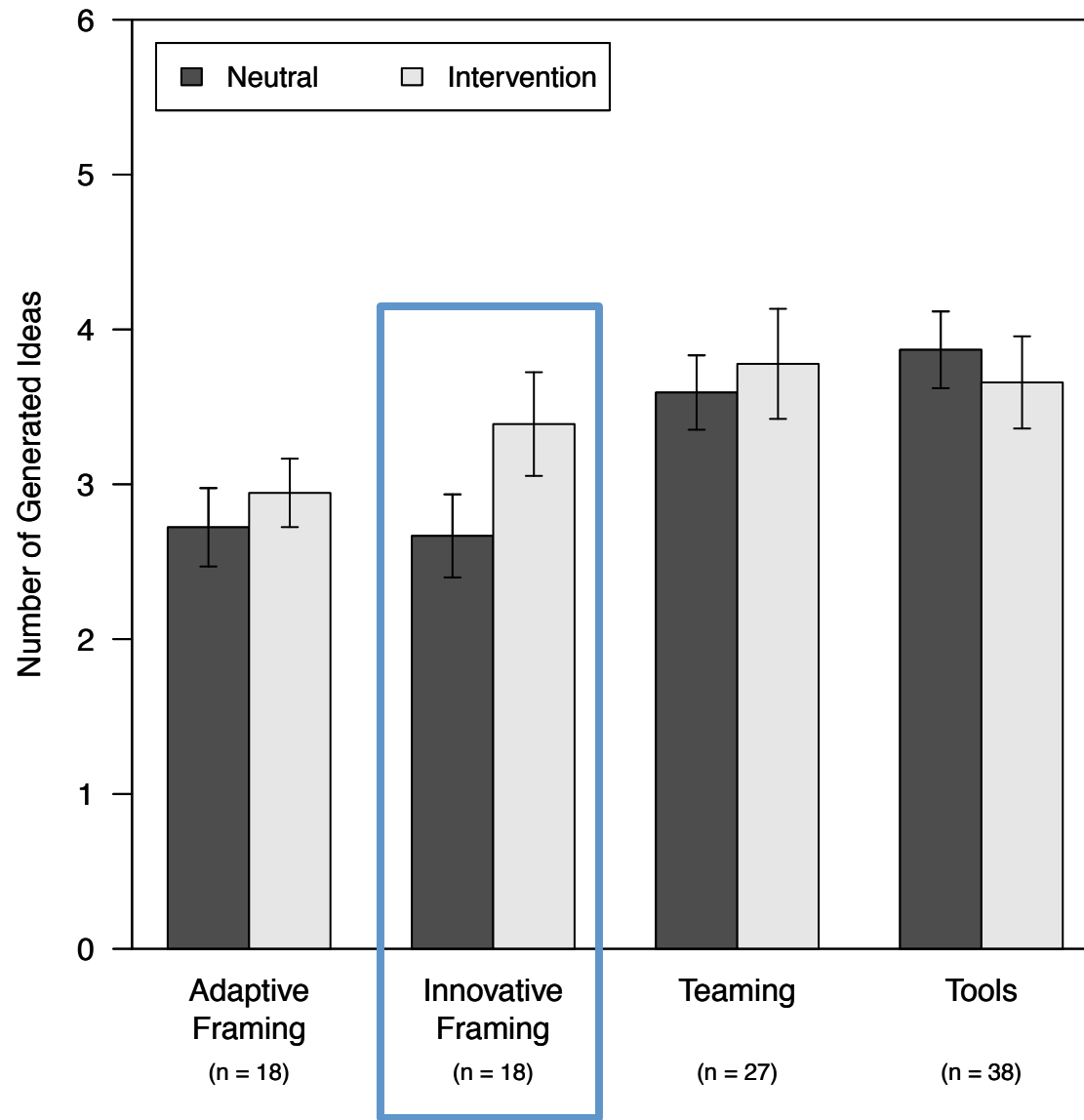
1 ... 2 ... 3 ... 4 ... 5 ... 6 ... 7
Very Neutral Very
Difficult Easy

“It wasn’t very hard to think of ideas, but I don’t think they were all very creative.”

“[The cards] made me think of more ideas, and helped me when I was stuck, but I think they also limited my creativity a bit. They were good starting blocks to help me come up with my own ideas.”

- 1. Alice generated more ideas and explored a broader design space with the tools.**
- 2. Alice perceived the tools intervention as helping, especially when she was “stuck”.**

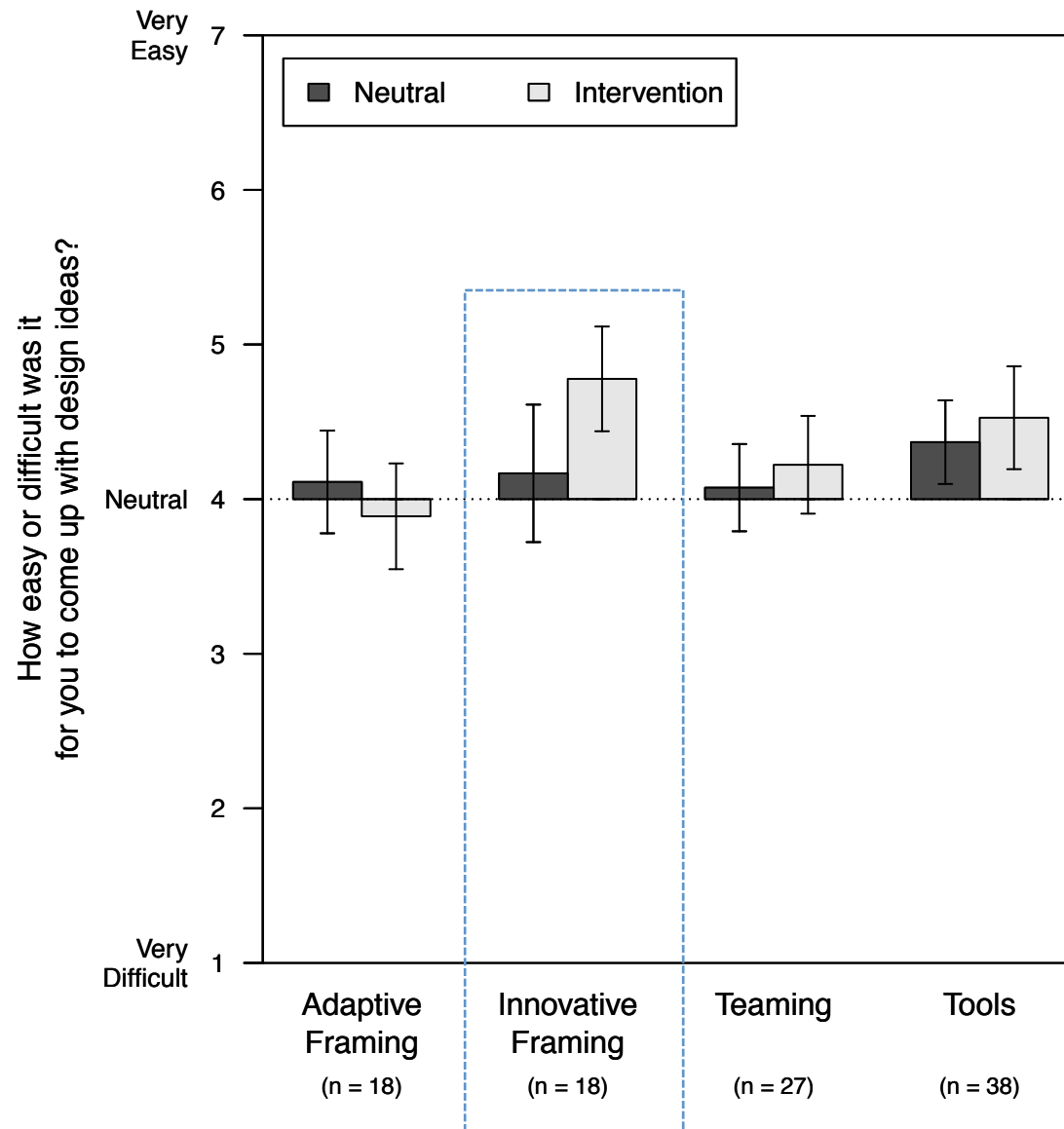
Quantity of Ideas Generated



Groups not the same at Neutral (pre)

Only significant pre-post change, was in *Innovative Framing* intervention

Perceived Difficulty of Generating Ideas



Groups not different at Neutral (pre)

Non-significant pre-post change in *Innovative Framing* intervention

Conclusions

The level of impact of the interventions was not high, suggesting that impacting novice ideation practices is difficult.

However, the innovative framing intervention showed promise, so relaxing constraints may be particularly helpful for beginning designers.

Open Questions

Is more practice (or time) necessary?

Is impact in other ideation measures (e.g., variety, feasibility)?

Are some interventions better for certain types of individuals (naive vs. intermediate vs. advanced levels)?

Thank You

Questions?

Eli Silk
emsilk@umich.edu

This research was supported by the National Science Foundation, Research in Engineering Education (REE) Grants #1264715, #1265018, and #1264551.

References

- Chusilp, P. & Jin, Y. (2006). Impact of mental iteration on concept generation. *Journal of Mechanical Design*, 128(1), 14–25. doi:10.1115/1.2118707
- Crismond, D. P., & Adams, R. S. (2012). The informed design teaching and learning matrix. *Journal of Engineering Education*, 101(4), 738–797. doi:10.1002/j.2168-9830.2012.tb01127.x
- Cross, N. (2004). Expertise in design: An overview. *Design Studies*, 25(5), 427–441. doi:10.1016/j.destud.2004.06.002
- Daly, S. R., Yilmaz, S., Christian, J. L., Seifert, C. M., & Gonzalez, R. (2012). Design heuristics in engineering concept generation. *Journal of Engineering Education*, 101(4), 601–629. doi:10.1002/j.2168-9830.2012.tb01121.x
- Jin, Y. & Chusilp, P. (2006). Study of mental iteration in different design situations. *Design Studies*, 27(1), 25–55. doi:10.1016/j.destud.2005.06.003
- Lemons, G., Carberry, A., Swan, C., Jarvin, L. & Rogers, C. (2010). The benefits of model building in teaching engineering design. *Design Studies*, 31(3), 288–309. doi:10.1016/j.destud.2010.02.001
- Linsey, J. S., Clauss, E. F., Kurtoglu, T., Murphy, J. T., Wood, K. L., & Markman, A. B. (2011). An experimental study of group idea generation techniques: Understanding the roles of idea representation and viewing methods. *Journal of Mechanical Design*, 133(3), 031008. doi:10.1115/1.4003498
- Paulus, P. B., & Yang, H.-C. (2000). Idea generation in groups: A basis for creativity in organizations. *Organizational Behavior and Human Decision Processes*, 82(1), 76–87. doi:10.1006/obhd.2000.2888
- Purcell, A. T., & Gero, J. S. (1996). Design and other types of fixation. *Design Studies*, 17(4), 363–383. doi:10.1016/S0142-694X(96)00023-3
- Shah, J. J., Smith, S. M., & Vargas-Hernandez, N. (2003). Metrics for measuring ideation effectiveness. *Design Studies*, 24(2), 111–134. doi:10.1016/S0142-694X(02)00034-0