Iteration: What is it good for?
(Adapted from the SCAD Conference keynote)

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Preface

• Preliminaries
  — Iteration is ubiquitous, not esoteric
  — Likely to contribute to the core subject of design process
  — My approach is eclectic (and reflective): you have to connect the dots

• Outline
  — Repetition is iteration’s first cousin
  — Iteration examples from limericks, music, and design
  — Lessons learned: what is iteration and what is it good for?
What do you see around you that is repetitive? Why?

• Reasons for repetition in MM- 103 Breed Hall
  • Economies of scale – chairs, windows, students
  • Safety – doors
  • Flexibility – lights
  • Standards – chalkboards, screens

• What about “redundancy” in people?
  • Insurance – arms, feet, fingers, toes, eyes, ears, kidneys, …
And there is a Lot of Repetition in Architecture
But, you are not spending time here to hear the obvious.

- **Our subject is:** the design process.
  
  "What is the role of iteration in design *cognition* or design *thinking*?"

  **Shift:** from “repetition” to “iteration,” the common term for process.

- **I will cover three things**
  
  - Learning from iteration in children’s limerick
  - Discovery of a musical “phrase” through iteration
  - Iteration by design experts in architecture

- **Will summarize the findings; and you need to connect the dots.**
What is Iteration?

• “iterate /ˈɪtərət/, verb, -ated, -ating
  • Origin (latin) “iteratus” = the act of repeating
    1. to utter again or repeatedly;
    2. to do (something) over again or repeatedly;
    3. the act of repeating; a repetition.
  • Cognitive Science: Procedure applied to the result of a previous one, as a means of obtaining successively closer approximations to the solution of a problem.
Anatomy of Iteration:

repeating successively for closer approximations to the solution of a problem

for a façade

make façade element → is the façade done? → done!

yes

no

repeat

in general

preposition → am I done? → stop

yes

no

iterate
Learning from iteration in children’s limerick
Children’s limerick: *Old Lady Who Swallowed a Fly.*

*There was an old lady who swallowed a fly.*
*I dunno why she swallowed that fly,*
*Perhaps she'll die.*

*There was an old lady who swallowed a spider,*
*That wiggled and wiggled and tickled inside her.*
*She swallowed the spider to catch the fly.*
*But I dunno why she swallowed that fly -*
*Perhaps she'll die.*
(continued)

There was an old lady who swallowed a bird;  
How absurd, to swallow a bird!  
She swallowed the bird to catch the spider  
That wiggled and wiggled and tickled inside her.  
She swallowed the spider to catch the fly.  
But I dunno why she swallowed that fly -  
Perhaps she'll die.
Children’s limerick: Old Lady Who Swallowed a Fly.

There was an old lady who swallowed a cow.
I don't know how she swallowed a cow!

She swallowed the cow to catch the goat
She swallowed the goat to catch the dog
She swallowed the dog to catch the cat
She swallowed the cat to catch the bird
She swallowed the bird to catch the spider

OK, we get the point, we have iteration: first the fly, then the spider, the bird, the cat, the dog, the goat, and the cow…. then what?
Children’s limerick: *Old Lady Who Swallowed a Fly.*

The iterative structure used in the poem is relentless but sets up the priceless finale:

*There was an old lady who swallowed a horse*

*She's dead, of course.*
Children’s limerick: *Old Lady Who Swallowed a Fly.*

**in general**
- preposition → am I done?
  - yes → stop
  - no → iterate

**in the limerick**
- special condition-1: begin by swallowing the first critter → is the critter inside caught?
  - yes → end by going too far
  - no → repeat

- special condition-2: end by going too far → am I done?
Children’s limerick: *Old Lady Who Swallowed a Fly.*

Why is this children’s limerick useful?

- It **simplifies** content that would be too complex, at the end, for a child
- It does this by performing **successive approximations**
- It establishes hierarchy: placing **detail** within **context**
- It provides a repeated structure – for **familiarity**
- It **teaches** about animals, taking risks ...

It has even been adapted to adults.
Discovery of a musical “phrase” through iteration
Discovery of a musical “phrase” through iteration

The Speech to Song Illusion (or transforming the problem)


• Accidental, infinite loop LISTEN: Sound Demo 1.

• Spontaneous transformation from speech to song LISTEN: Sound Demo 2.

sometimes behave so strangely
Discovery of a musical “phrase” through iteration

The Speech to Song Illusion (S2SI)

• Prof Deutsch found that “S2S Plasticity” is sensitive to:
  — jumbling of syllables (no melody is perceived),
  — the LACK of repetition (no melody is perceived)
  — transposition of repetition (no melody is perceived),
Iteration by design experts in architecture
Iteration by design experts in architecture

Iteration Type One: **In the beginning, find many, alternative starting points.**

- What is the role of many starting points in the solutions space?
- In the example of a carriage-house design problem these alternative starting points are:
  - Place carriage house *over* existing garage
  - Place carriage house *under* existing garage
  - Place carriage house *in place of* existing garage
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Iteration Type One: In the beginning, find many, alternative starting points.

• Observe that the designer, thinking in breadth, considers each alternative laterally and then develops one (placing the carriage house on top) in depth, or vertically, through several detailed issues, like orientation, geometry, layout organization, and plan parti.

• In another layout design problem experts display similar breadth-first-depth-next search with different top-level design options: location of entrance and private versus shared space
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Iteration Type One: **In the beginning**, find many, alternative starting points.

_Akin (1990)_
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Iteration Type Two: In middle design, exploring with the Simple to Reach the Complex

Question-2: With the limitations of the STM, and the myriad of design issues – which may include orientation, geometry, layout organization, and plan parti or concept, etc. – can targeted solutions to such design aspects be taken to their successively approximate comprehensive solution, all at once? Or, do designers use a piecemeal approach that accumulates partial solutions into complete ones?
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Iteration Type Two: In middle design, exploring with the Simple to Reach the Complex --

Three-way Integration –

Based on the “Design Thinking” Research, in 2007, London, G,B. In this case, I observed that when design is carried out by a team of designers the number of design issues processed at once can (modestly) increase.

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Iteration Type Three: In the end, finishing after looking at many solutions–

Question-1: How many solutions are needed? In other words, how many times a designer should attempt before terminating design (either a solution or a dead-end is found); each iteration being a full cycle of picking a starting point and carrying out successive approximations until none needs to be carried out?
Iteration in Design Cognition

Iteration Type Three: In the end, finishing after looking at many solutions–

Design protocol experiment in which subjects solved one of three different sites with varying levels of difficulty. Say:

- Place carriage house *over* existing garage
- Place carriage house *under* existing garage
- Place carriage house *in place of* existing garage

- They found many distinct solutions before settling down to one.
Iteration in Design Cognition

Iteration Type Three: **In the end**, finishing after looking at many solutions –

- Participants:
  - Non-architect (N)
  - Beginner/student (B)
  - Expert Architect (A)

\[ I_{(Architect)} > I_{(Beginner)} > I_{(Non-arch)} \]

where I is the number of iterations
Take-away: Notes On the Anatomy of Iteration

• **Iteration at Large**
  - It helps *approximate* a solution through repetition; reach *complexity* through simple steps; and achieve precision through *detailing* in phases

• **In Architectural Design**
  - Experts consider many alternative beginning options
  - Experts manage design *complexity* by pairwise (three-way) integration
  - Experts decide on a solution after finding many alternative solutions

• **Process and Product Dependency**: iteration-based *designing* leaves iteration-based marks in *designs*

• **Designer’s Cognitive Mechanisms**: in the ease of learning, *designing* is cognized by the same iterative information processors as are *designs*
Iteration: What is it good for?

One thing is for sure: It is good for learning.

QUESTIONS?