Final Conference Version Submission 9/1/2015

Guiding Patterns of Natural Design: Mining Living Quality, A Pattern Language Approach

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Contents

ABSTRACT

Pattern language is built around designs for providing services, expressed as "patterns" intended to identify a "simplifying ideal" for solving a recurrent problem, ab organizational solution with significant "emergent properties". This paper discusses ways of learning from naturally occurring designs with those properties, to increase the "living quality" of design patterns of all sorts. That is done not so much by enhancing internal features as by discovering needs of their external relationships. Those are the pattern's relationships with the living environments the pattern is both served by and serves. Ways of finding living examples to learn more about that interface are discussed. Those are first introduced with a pattern for "Mining Connections for Living Quality" and discussed in relation to two pattern designs presented at last year's PLoP meetings to illustrate. The background of this work, general theory and resources are discussed in following sections. This paper is an extension of a companion paper presented at PURPLSOC 2015 in Krems this year (Henshaw 2015), on a general method for studying the organization and evolution of naturally occurring patterns of design, for informing, guiding and serving as a resource for developing pattern solutions generally.

Key Words: pattern language, natural patterns, pattern mining, living quality

Tables

Figures

Review note: Paragraphs in development are indicated with this color and line spacing,

MAIN BODY

1. INTRODUCTION[1,2]

The paper begins with introducing a design pattern: "Mining Connections for Living Quality" (Table 1. & 1a.). It's a method for examining a design's connections with the living world to both validate and add richness to any intentional design, a very general pattern for learning from a pattern's interface with the natural world. That method's use is first briefly discussed in relation to two papers presented at PLoP 2014, and then background on the studies it came from, theory and resources for its use are presented.

I felt the main application would actually be easier to understand, as it follows the familiar model for describing a design pattern, and would be a good way to introduce the perhaps less familiar subjects to be addressed later. Leading with the practice rather than the theory is also responds to the general finding that practice and theory are much more intertwined than we often realize. In part it's that in practice you see the difficulty of the problems you need a theory for.

So as you read the application, it is hoped that your questions about the theory needed will be brought out by thinking how you'd adapt the method described in your own work. As the reader considers what the method might be used for it would expose new problems and possibilities along the way, to make the theory and resources more interesting and useful. Starting that way does make the reader do more work perhaps, but also might give them more of their own ideas to reflect on when reading the discussion to follow. Having one's own questions on the subject will also help with making use of the longer companion paper, "Guiding patterns of naturally occurring design: Elements" presented at PURPLSOC this year (Henshaw 2015), as a general introduction to the subject.

[1] This paper for PLoP 2015 accompanies the July PURPLSOC 2015 paper (Henshaw 2015), also linked here
[2] Contact sy@synapse9.com, website http://synapse9.com/signals

2. Mining Connections for Living Quality

Designs embedded in a living world

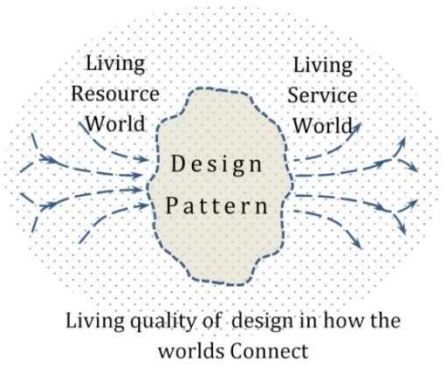


Fig 1. Flowing connection

Table 1. describes is a general pattern to use for bringing more living quality to designs. It's meant to be largely self-explanatory as a starting point for discussion, to be read in relation to the work of practicing designers, thinking about ways of improving the living quality within their designs and in the connections their designs make with the living world.

An idea of how a design pattern as imbedded in a living world is illustrated in Fig 1. The idea of mining a design pattern's connections to enhance their living quality can be thought of as looking for ways of making better connections, in how the design's pattern serves those connections. Any design receives services on one side and delivers services on the other, and generally also exists in an environment it needs to be a responsive part of too. The "living quality" of those connections can be thought of as what it is about the services received and delivered that responds to the "whole need" being served.

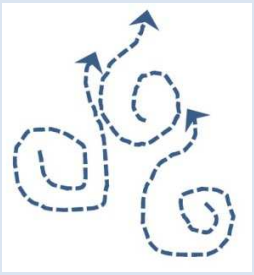
I often think of little examples for illustrating conceptual principles like these, such as "whole need" in relation to a traveler on a wet night entering a restaurant, finding there either is or isn't help in finding where to put wet clothes. In general, the needs that designs served are complex, and important secondary needs then hidden from view. So the idea in asking if any connection serves the "whole need" is to look into the complexity of the need for what the living system being served really needs. So a designer has a complex task of understanding and being responsive to serving other's needs. As if looking for "bottlenecks" in serving their own design's need to be a "center" of living quality as an ideal of pattern design, they look for hidden needs that would best serve their whole purpose.

To do that a designer really needs rich experience in noticing the complexity of the needs their designs serve. They need ways, in as sense, to "look under the rocks" and see how naturally occurring designs interweave complex networks of services for living things to thrive, Finding where the network being either used or served is then not thriving, can be a sign of something altogether, or missing at the time it's needed. Both of those kinds of observations really require developing a practice of noticing how the patterns of natural design develop.

The first place we find them is in what we know most intimately, of course, in thinking about our own experience.

The general technique proposed here stats with a way of searching one's own experience with a simplified pattern of what you're looking for, a technique we'd call "pattern search". If you think of an intended service to be provided, you can learn more about it by forming a more general idea of it. For example, instead of the service being something specific, like "docking", you might generalize the idea to "meeting", and use the more general pattern to explore living examples of how "meeting" arises in natural circumstances and is both well and poorly served. That's the general idea.

It gives you a rich contextual understanding. The key is to generalize a recurrent element of design in a general enough form to use as a search pattern. Then search your experience for where varied living examples might be found to learn more from, and from that expand your search and gain experience as you are led to.

<table>
<tr><td>Table 1.</td><td colspan="2">Mining Connections for Living Quality</td></tr>
<tr><td>Search Method: ##</td><td colspan="2">Pattern Domain: Joining intentional and natural design patterns</td></tr>
<tr><td rowspan="3">Image:
 
Living Quality</td><td colspan="2">Context:
• Working on a partly completed design pattern</td></tr>
<tr><td colspan="2">Forces:
• Designing for both a problem and the world in which it has to work
• Need to study secondary effects after having solved primary ones
• Seeking a quality of response to the design from the environment</td></tr>
<tr><td colspan="2">Resources:
• The design pattern and its world of connections,
• Our connections and Our life awareness of connections
• Our ability to recognize an environment displaying living qualities</td></tr>
<tr><td>Concept:
• Use your design pattern to lead you to better ways to serve the things connected to it.</td><td colspan="2">Solution:
• We search in the design pattern's external connections to see how well they are served, and looking for unserved secondary needs.
• We also use the pattern to look for kinds of naturally occurring examples, to observe what nature tends to add to the pattern and so feed our imagination of how thriving environments work.</td></tr>
<tr><td>Table 1a.</td><td colspan="2">Supplemental values</td></tr>
<tr><td>Theory:
• Expanding the possibilities in the near environment adds to its fertility and resilience, serving the whole.</td><td colspan="2">Stages:
• We first review places to search, types of searches and do a survey.
• Then select where to drill down into for detail, If available, use teamwork to share the effort and digest what is found.
Other useful results:
• Is a good way to check & validate designs before passing them on.
• Exposes nice finishing touches while still in design on the whole</td></tr>
</table>

The pattern description template above is a hybrid, adapted from a more standard form (Fig 2.) and an expanded form (Fig 3.) for recording the patterns of naturally occurring designs and their added complexities. They're shown in the Slides[3] and discussed more in Section 3.5 of the companion paper (Henshaw 2015).

Describing organized intent

Name	Context	Forces
Image 	Problem	
	Solution	
Subject	Actions	Results

Fig 2. Basic design pattern template

Describing natural organization

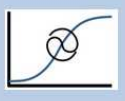
Name type	Problem Boundaries & Scales	Forces Resilience & Animation
Image 	Context – Arrangements of : • Centers • Roles & • Stages & • Movements	
Simplifying Relationships	Object Domain & engagement	Solution Learning process
Links	Results, Tracking, & Adjustments Anticipated Open questions	

Fig 3. Template for natural designs

The main difference between describing intentional designs and naturally occurring ones is, of course, the presence or absence of a designer. Natural designs generally come from some starting pattern of design that grows to maturity in its environment. We're very familiar with that as the business that can't start without a start-up plan, or a student who can't get an education without getting an education. Natural designs are always found to have come from "start-up" event too. For a community of vendors that develops in a certain section of town, the start may have been some "volunteer" vendor who tried it and others that copied. You may know examples of that in your own town. It's generally something like that, where one thing creates a start-up pattern and then its growth follows a natural course. At each stage of development you find natural systems display a design pattern stemming from the original pattern.

For this exercise we can mostly stick with familiar pattern language terms and methods. How naturally occurring designs can be thought of in terms of the end pattern of working relationships they form, much the same way as patterns for intentional designs. The one detail related to how they develop to keep in mind, is that naturally occurring designs express the pattern of the seed of organization they begin with, in immature ways at first and then in mature ways later. A simple example would be to compare the habits of a

[3] Slide 8 -http://synapse9.com/_PLref/2015_PURPLSOC-jlh-Slide-08.jpg

young struggling waiter and a sophisticated older one. We can see those patterns in terms of the unbalanced forces of one and the balanced or even artful practices of the other. They might each have been given the same starting pattern as a guide, but just be at different stages of becoming masters of the craft. If you are a designer for the restaurant you might notice, and check to see if the accomplished waiters are sharing their tricks with the new hires. So that way we can see the patterning of natural designs in familiar terms.

3. EXAMPLES USING PLOP 2014 STUDIES

Without going into much detail I discuss two studies from at last year's PLoP conference, looking for how they might be further enhanced with living quality by exploring their living connections,

3.1 For Pattern Illustrating

Harasawa et. all. (2014) discussed a method of developing pattern illustrations, taking suggestion from evocative words, they termed *"center words",* found in the pattern descriptions they had worked on. (Harasawa et all. 2014) defined as :

> "The words within the pattern which hold strong meanings that you think are critical to represent the essence of the pattern. …. words are extracted out to form the image of the living structure of the pattern in our heads."

As a note on language, I'm showing the term "*center words*" in italics here, to indicate it is to be interpreted as discussed here and not as a general term, and do the same with another expression, "*working words*", to be further introduced later. I note that many patterns of intentional design are given evocative names "in a suggestive spirit" that would be illustrative of the working features of the design, and so closely fitting the usage for "*center words*" Harasawa et all. gives it. One could also name patterns with words that directly characterize the working organization of the pattern, to be termed "*working words*" here.

The use of evocative terms to suggest ideas for illustration naturally draws on the rich associations naturally derived from our cultural sharing of life experiences with important natural circumstances. The assumption is that the collection of such words found in the text will uniquely suggest an image to symbolize the meaning of the pattern described with them.

To very briefly summarize the group's findings, the group first collected and categorized types of "center words" from the whole collection of 108 design patterns developed in their

lab, finding some 500 different ones, which they categorized in 13 groups 6 categories "Composition words" and 7 of "Element words" (Table 2. & 3.).

Table 2. Groups of Center Words for "Composition", evoking:

• Forms of Power	• Patterns of Arrangement
• Directions of Power	• Forms of Status
• Movements of Power	• Periods of Time

Table 3. Groups of Center Words for "Elements", evoking:

• What	• Feelings / Temperature
• Properties of What	• Atmosphere
• Actions	• Properties that evoke feelings or atmosphere
• Properties of Actions	

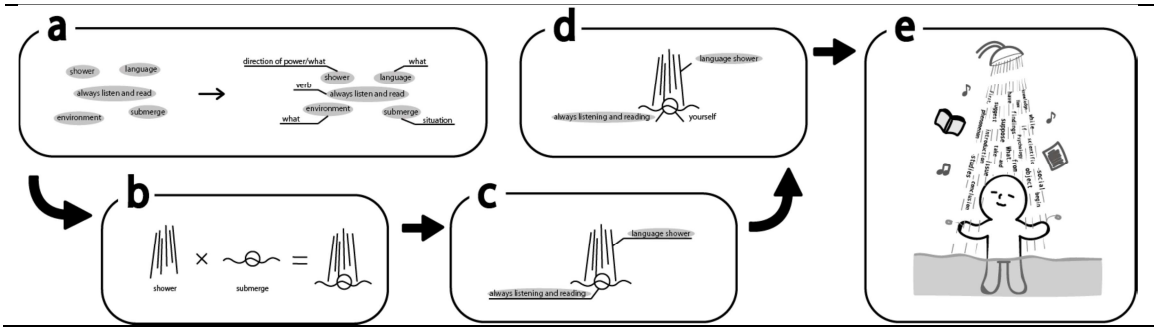
Then to develop pattern illustrations for each individual pattern, they collected and organized the center worlds found in its description, and looked for those words to express a holistic "living structure", suggesting a vision, that became the illustration.

Table 4. Steps of Pattern Illustration

1. "Finding Center Words" - in the descriptions having strong meaning
2. "Creating the Living Structure of the Pattern through the Center Words" - studying its center words to envision the "living structure" as a whole
3. "Drawing the Pattern Illustration" - to express that vision

The example presented was for illustrating a pattern for language learning using immersion in the language and culture being learned, they had named "Language Shower". The steps of the process were illustrated and the final image show as "**e**" below (Fig 4.), an enriched image of being immersed in a language shower. The basic steps taken would be about the same, actually, for mining images with living qualities from naturally occurring designs, with the exception being that the latter would be more focused in searching in the living connections of the pattern with its environment.

Fig 4. Steps of Composing the "Living structure" and Illustration



A Symbol of Thriving

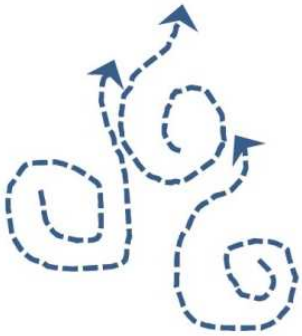


Fig 5. Living Quality

You can see the similarity between the method of Harasawa et. all. and the pattern for mining living quality described in Table 1. In developing the symbol for "living quality" used I did not explicitly extract the evocative "*center words*" from the completed text. I sort of did the reverse. I found a symbol to evoke the intention and illustrate the pattern, Fig 5., before most of the words for the pattern were written. I was looking for guidance on how to write the pattern, really, and felt I needed a strong symbol before I could complete the text. First I did an online image search, using all the descriptive terms I could think of. After some effort not finding anything ideal, started drawing symbolic diagrams of a design pattern nested in its connections, Fig 1.

That was very good, but it had little feeling of "living quality". I found myself thinking of situations closer and closer to the what happens at the complex intersections of living services, where the living quality of healthy environments emerges, and the environment grows in around the implanted design, what Alexander, I believe, means by "fitness". It's what happens at those nodes of complex "semi-lattice" intersections, the "street corners" that attract life that thrives, where the living things discover all the new connections available. That's what I needed to capture somehow. I recalled a doodle from a few weeks before, and worked with it until I noticed a group of discards close to this version of it (Fig 5.) at the side of my drawing screen, where I was pushing aside my various attempts, reminding me of "little motions coming together".

That happy accident also brought out the similarity of my process with that of Harasawa et. all. The one real difference I think is my search being specifically aimed at pushing outward for suggestions, searching the design pattern's living connections with the environment for the meaning.

One suggestion is that testing multiple objectives and ways of doing a search may be valuable, because it seems until you find what you want, you could possibly not know what you are looking for. The main steps I took in drawing the pattern for "Mining Connections for Living Quality" was first to generalize that a "pattern" is always a vehicle for serving the complex needs of networks of living things. That gave me images from the rich terms of pattern language of where the "semi-lattice" intersections to which living networks could be attracted.

3.2 For Mining Software Patterns

Several techniques for mining software design patterns from finished programing were explored by Hanmer & Mirakhorli, (2014). My own understanding of software design patterns is relatively limited, not having done professional programming, so I mostly interpret them from the verbal descriptions. Their "Software Archeology" approach uncovered and described a whole catalog of types of computerized scheduling design patterns.

Natural systems don't have "software", of course, but many functions of software do mimic or replace naturally occurring processes, such that studying them might suggest natural design solutions a programmer could mimic. The general idea of pattern language is also that the implementation of a pattern could be in any suitable language of assembly, independent of the pattern description. So though the working assemblies for software coding and the organic forms of nature are extraordinarily different in kind , if we can show the relevance we can still speak of them as examples of the same or related patterns.

Nature does a great deal of "scheduling", for example, getting things to show up when and where they are needed. Natural designs both display highly complex but still mysteriously efficient methods of scheduling. Mysteriously productive highly inefficient methods of scheduling appear in great variety too, as apparent widespread features of natural complexity, oh like "pollination", we are maybe only beginning to appreciate. It may even seem "wasteful" for nature to use so many kinds of "mediums of exchange" (like 'markets' and 'resource pools').

For 'scheduling' material deliveries nature simple scatters things, with no recordkeeping at all, to match provider and user for vast quantities of essential deposits and withdrawals. All the main resources of life are just deposited to pile up that way, with no end purpose attached, as repositories of goods of some pattern to be mined and used by whatever user comes along to put them use. The roles that mediums of exchange serve in life seem so strange to us, then. As to whether a pattern for a service really serves its environment, thought, the question still comes back to asking, what will others get out of what you are putting in the pool?

The application Hanmer & Mirakhorli present leaves us mostly to speculate on those issues, describing neither how the types of scheduling patterns were found or condensed, nor what the coding maps for them mean. So to generalize a design pattern to use in searching nature for related examples we have only the names of the eight types of problem types and names of the patterns types they found for them(Table 5.). Though the description is very limited it appears that they were intent on and did perform a fairly exhaustive search. In natural domains like "the world of software" implied here, having a way to be "exhaustive" and press the search to natural limits, can be quite important to do. Only by having a way of exhausting the limits of the searchable domain do you find what domain you searched.

What they found were eight types of scheduling problems a different common pattern for each. They also found nice crisp and evocative titles for the problems and software design patterns for them found, though no discussion of why those names were given. The problems identified were generally named using "*working words*", as discussed above, and patterns named using "*center words*". So to look for naturally occurring designs to learn from, for these eight software patterns, we need to first work backward from just the names given, to intuit a design pattern image general enough to be used for searching with for examples from our natural experiences. So we try to imagine how the names imply its roles in its environment, to have some image on which to search for related ways of coordinating services in nature.

Software Archeology (Hanmer & Mirakhorli 2014).

> Utilize software analysis, design discovery, architecture reconstruction and visualization tools to mine software system source code. Detect new notions of design, hybrid approaches to problems and tacit forces in architectural choices.

Their approach considered the problems and issues related to various manual and automated methods, and selected one combined method to use for demonstrating a wide search for computer scheduling patterns:

> 1. An automated design discovery techniques called Archie, for detecting high level design decisions known as architectural tactic in several software systems.
> 2. A design pattern discovery technique to identify the cases where architectural tactics were implemented using design patterns.
> 3. An overlap analysis was performed to understand forces and variability points across each tactic.

They diagramed six kinds of software scheduling problems two of which called for different types of patterns in different contexts (Table 5.) The impression is that a fairly exhaustive search of a large variety of source examples, uncovering a fairly inclusive group of scheduling design pattern types, for which suggestive names were chosen. It's because suggestive names seem to have been chosen that makes it possible to think of the word's root meanings and look for related examples in other contexts that might be described using the same words. In the next table (Table 6.) I suggest naturally occurring designs found in living contexts, that might patterns of design for their fitness in the environment to learn from. In column 'C' I'm using "*role names*" or "*place names*" for where to look in your experience, lacking common names for natural patterns of design. In column 'D' I list working "*properties*" that I was thinking about in making the associations between terms in column 'A' & 'B' with terms in column 'C' . You may think my inability to really understand the software patterns discussed reduces the quality of my suggested matches in nature, or after thinking about what nature is doing in those cases see enough connection to be of interest.

Hamner Software Scheduling Patterns				J.H. Natural pattern mining suggestions	
A.	a.	B.	#	C.	D.
Problem	Context	DP Name		Naturally Occurring Design	Relating Property
1 Many tasks		• Flyweight	1	• Sweeper, Dealing, Dispatch, Batching	• Repetitive small tasks
2 High resource demand		• Proxy	2	• Producer, Manager, big team	• Complex tasks
3a Stateful tasks	Complex	• Memento	3	• Cooking, Day & Night, Politics	• Transformation in forms

3a	Task monitoring	Simple	• Observer
4		Complex	• Composite
5	Remote task		• Proxy
6a	Multiple task	One-step	• Bridge
6b		Multi-step	• Adapter

Table 5. The Patterns Found

3a	• Hat Check. Host, Bouncer	• Status change
4	• Test Drives, Rehab, education	• Graduations
5	• Drone, Subsidiary Pollen, Circulation	• Secondary processes
6	• Restaurant Menu, EBay, Market picks, Acquaintance	• Complex choices
6b	• Sous-Chef/Waiter Triage, fractioning	• Complex performance

Table 6. Other kinds of examples

To discuss just one example, consider lines 6a 6b, associating:

- 'Multiple task' 'One-step' scheduling called "Bridge" with "restaurant menu"
- 'Multiple task' 'Multi-step' scheduling called "Adapter" with "restaurant waiter".

The great diversity of items on a menu is a scheduling problem primarily for the diner, deciding what to order. We all know that problem. It's fairly complicated, and often gets put aside while you chat, having finally sat down, so you're not ready for the waiter, but like getting attention anyway. The scheduling task of the waiter is rather different, and shared with others in the kitchen, for working at peak efficiency to deliver what is often a quite complex service. The great diversity of meals to prepare becomes a scheduling task for the Sous-Chef, and also for the prep cooks and so on, because getting a restaurant kitchen tow work smoothly is a complex art. That's the image I get from scheduling described as "multi-task, multi-step, adaptive". You might find other examples too.

The waiter is basically put in command of a diverse set of carefully prepared resources, for serving the different types of things that different customers come in for, and the work in the kitchen has to be coordinated to come out all at once, though the meals to be prepared may be very different. Here's where you get to consider the secondary design patterns needed for the resource environment to work. The special stocks and preps for making the meal and the finishing touches added to both food and service, that are so important to the whole service to be right, don't seem to be part of "the meal" at all. The "stocks" and "preps" ready to use speed preparation of complex meals and extend the shelf life of the ingredients. Finishing touches help make it a delight.

How the kitchen staff works is to learn multiple roles, developing their own culture for organizing its ingredients and working as a team. It lets them approach each order more like an original performance, coordinated with the waiter, all *so the whole operation can*

work smoothly. On the waiter's side the finishing touches of serving a meal may or may not change their tip, but can have a big impact on a guest's satisfaction the "comity" in the room, and the likelihood of the guest becoming a regular customer.

3.3 Between program and performance

All in all, what you find in the scheduling of tasks in a restaurant is a logically simple exchange of money for a checklist of food items. That's all you see. In how it's done, the living qualities of both the served and serving connections become part of the design too, built into the process at every step for the whole to run smoothly. There's a matter of "sufficient variety" (Ashby 1958), needed between the quality of service being provided and the actual coordination and performance of the work. In places that care about that, problems with the quality of service are quickly notice and the right changes made.

The kind of satisfying service is indeed visible often enough, as a learned responsiveness to the needs both served and serving connections at every level, in thriving cultures it seems to flow all along the chains of exchanges as what makes the whole work as a whole. We talk about "sustainability", and this property of the whole would seem of lead importance, but we don't really know how to trace it yet or change it. By far the most impact of any design, like a business, is not in how it operates, but through what it serves or where the money comes from or goes to, quite hidden from anyone's view, really. So perhaps understanding our real roles is something else pattern language can help with.

The presence of qualities of responsiveness throughout a design, as in the patterns of good friendship, a great family, or a good business, are real things. They also seem to have a common character closely related to each individual one's individuality too. The living character of a fine restaurant, and its individuality, can also be found in a food cart, in how it's coordinated services work as a whole. While some successful business brands are perhaps just better at faking it… others sometimes express that same living quality of the whole organization and culture they represent too. National symbols sometimes express the real national character occasionally, like the Statue of Liberty seems to do unexpectedly well for the part of American culture that makes 'liberty' work so well for the US. The quality of relationships that make that work as a symbol, like the culture of a great neighborhood or restaurant, is what the symbol symbolizes, and isn't transferrable, but shared and learned.

4. BACKGROUND AND THEORY

4.1 Building on Alexander, Jacobs, Goodwin

One of the reasons it seems unfamiliar to discuss the details of naturally occurring designs is due to the language deficit our culture developed. The sciences have largely studied rules of prediction we could discover, to isolate what we can control in nature. Throughout history, really, science has intensely studied just one side of life. That has resulted in the whole human race, really, having failed to carefully study the "non-steady" types of emerging organization, development and transformation that dominate the natural world, as the crucial systems of life. It's one of the reasons scientific models seem "lifeless", describing the world as having fixed relationships rather than energetically evolving ones.

So to discuss naturally occurring patterns of design we need both new methods of study and terms of language, such as pattern language helps us develop. Pattern language helps us look at complex circumstances to find simplifying ways to balance a spectrum of forces, and to be generous enough so that our designs have resilience be welcoming enough to smoothly fit into their environments. That unavoidably defines the designs we wish to implement as actual conversations with nature. It's one of the things that architects have always dealt with.

Culturally we then need to expand develop new pattern recognition skills, and learn to shift our attention back and forth between perspectives. Having been accustomed to defining nature with rules in our heads rather than a world of independent partners, one of the hardest things is learning to look back and forth between the design we are working on and the patterns independently defined by nature, that we need to work with. We'll keep using deterministic models, of course, but just as tools rather than defining our world, as real designs need to be looked at from all sides.

What most distinguishes information models from natural designs is that information models need defined terms to be self-consistent and not have an environment, while natural designs emerge directly from their environments. Models rely on rules for connecting information grouped into categories people define, so to use them with nature we'd need to find ways to collect information by categories the forms of nature define. Natural systems are held together by the patterns of relationships that emerge as they grow and develop, to form and connect unconnected things, as they emerge from their own environments more or less by themselves, by processes that are changing everywhere at

once. What we have to rely on begins with our direct experiences, as nature's forms and meanings are in fact all "non-verbal" (well except for our own words of course)

Christopher Alexander's attention to detail frequently crosses back and forth between those theoretical and natural world perspectives, and pattern language has it directly written into the format of pattern definitions too. The information recorded in a pattern doesn't define a design really, but a set of learning principles, for what to look for more direct connections with in the environment. It defines a learning process for considering multiple "orthogonal" views, in the course of doing a design: plan, section, and life, you might say. The interest is as much to be alert to discoveries that might be made in the process as in engaging with the forces that need to be balanced.

My first introduction to Alexander's way of learning from multiple viewpoints as a method was in the early 70's, hearing of his interest in tracing the evolution of designs as a pattern when studying design at the University of Pennsylvania school of art and architecture. How my work evolved since then partly inspired by that is discussed more in the companion paper (Henshaw 2015). I was led to studying the patterns of how naturally occurring designs evolved by themselves, rather than by intent. The main breakthrough, it would appear, was noticing that natural designs quite generally develop "individually", and when looked at that way can be seen as going through distinct stages much like any learning process does, except missing the designer. So taking such a different direction I didn't really see how Alexander's main body of work was developing (1965, 1977, 1987, 2001-6.) until long after it was adapted for software development (Rising 1998, Tidwell 1999). It was when my work turned more toward education and ran into educators and theorists contributing to PURPLSOC and working toward developing pattern language as a general science, that I noticed the match (Schuler 2008, Bauer & Baumgartner 2010, Finidori 2014 2015).

As my unusual methods for discovering and describing individually emerging natural design patterns developed, I also learned a lot about natural forms of design from a variety of wonderful ecologists too, of course, and influenced by "deep ecology" as a discussion of the uniquely individual designs of nature, their individuality and inherent worth. Brian Goodwin and Richard Solé are examples (Goodwin 1994, Sole' & Goodwin 2000) among others. I spent a lot of time immersing myself in and writing papers for many other sciences too. The preoccupation of science with using deterministic rules, representing every subject of nature with rules for numeric variables, while making no studies of individual natural organizations made it difficult, of course.

Lots of accomplished people in all walks of life, of course, do try their best to render images of natural designs and natural change faithfully. I think Jane Jacobs seems to come closest to being consistent in talking of naturally designs as occurring naturally, a really important mind shift, is also seeming to be very rare. of course. Jacobs was studying cities as very alive quite individual things. Her subject was to study the individual transformations and emerging patterns of design, and the differences between them. She also focusing on the "living quality" of thriving urban centers, and how their cultures "erupted" and was also completely missing in other places, a very similar two part curiosity like mine, and it seems Alexander's too (Jacobs 1961, 1970, 2000). For her, the creativity of cities and economies derives from a complex of overlapping organization, similar to Alexander's observation of the role of "semi-lattice" patterns in "A city is not a tree" (1965) as attractors for life.

What I think may be interestingly different in her approach from Alexander's, that jane's natural point of was to consider cities as living things themselves, composed of the living arts and what they built to live and work in. That's much like the conclusions I reached, that natural systems have active and stable parts, the active parts building their own capital infrastructure as stable parts, each shaping the other as they develop together.

Alexander seems to draw the living places for living things and the things living in them as somewhat separate, as for building architecture they mostly are. A way to unify the two views is to see the building designs as having grown more or less like natural systems during the progressive stages of design in the designer's studio. That' where the creative emergence of self-organizing design occurs for building, in the strongly opportunistic and very history dependent series of design development stages in the designer's office.

4.2 Repositories

For being guided by natural design there are also many kinds of natural pattern repositories. Many are ones we know quite well too, but just never thought of using them that way. The greatest repositories for patterns of human knowledge are our own cultures, for example. They are both prominently visible, like the top of an iceberg, and have vast hidden depths and structure you can only find by having ways to search them. Our cultures actually carry all our vast resources for verbal as well as non-verbal knowledge, as the total of our knowledge of "how to live" and "what things mean", like a huge "reference library" of collected "human practice" with deep roots in our most ancient history.

We pick up extensive patterns for understanding how people relate from our deep cultures, building our own version of the whole as we absorb our culture's meanings as we grow up,

We then also share our experience with others to constantly refresh the permanent record as we live. You also see great variation in cultures, all having strong prehistoric roots and maybe seeming universal to people within them, and might find multiple cultural changes going just from one block to the next. As you walk around any city, town or village you see in the differing designs, materials, values, attitudes, manners, priorities, etc, all expressed in practices and styles of how people live. It makes "the environment" a far more richly endowed place of ancient knowledge, literally, full of pattern repositories for every shade of variation between cultures. It's important to frequently think about what is hidden from view. That's both because what's hidden is the bigger and more persistent part of the culture, and also easy to misunderstand how a culture is or can change considering just what you can see.

4.3 Brief summary of methods

As stated in the design pattern for "Mining Connections for Living Quality" (Table 1.) the basic method is to follow associations with the pattern being worked on to discover from living examples of related natural designs to learn from. Two strategies were suggested:

1. Following its connections to the living things serving the design or that the design pattern serves, to see how well their needs are served.

2. Looking in nature for living examples of other cases of the design pattern in nature to understand how the environment heals in around them

Both approaches may take some thought and effort to make useful, starting from thinking of other ways you already do the same thing, having need to solve a "dinner", "boyfriend", "vacation" or "car repair" problem and reducing them to an image or informal pattern, to search the world for hints on the options. When designing services for others you might be more thorough and focused on technique. In all cases you use the pattern you want to learn more about to help with searching your own recollections of living experiences to find ones to learn from. That could be done in a group too, to combining experiences and imaginations. More diverse perspectives might be valuable for patterns having to do with needs of living cultures, and what way of offering services they are drawn to and apt to make part of their environment, and heal in around, or the reverse perhaps, to avoid having a service taken over by a dominant user, and remain free for individual users.

Searching connecting lives and environments for unmet needs has lots of side benefits. It's really essential to develop an image of the pattern being worked on

as a whole. It also helps on avoid our natural subjective biases, exposing you to connecting natural circumstances outside the bounds of being designed for, and so often not fitting one's usual assumptions. It helps expose unmet needs you might respond to, but of greater importance may be becoming aware of needing to not make worse. For example when designing a customer service phone tree, do designers ever compare the ratio of hours of time saved for employees with the hours of time lost to the public? Or when designing a new building for a business, you would never just talk to the owner. To design for the whole system you need varied views of the business culture, its neighborhood communities, the lives of its customers, users and suppliers. You could certainly use up a lot of valuable time doing that too, of course. To be able to do the simple things, thought, you'd need to have looked at the complexity and unmet needs of the connecting environment to even know what to respond to. Being a "good neighbor" and generating "good will" are highly valued commodities, even internally between objects within a software package. You just wouldn't know what creates them unless you had d looked at the complex needs of the connecting networks,

Sunshine falls on the whole world, not just the little pieces we work on. The second approach suggested is do a wide search to learn from interesting distant examples, either of related living examples of natural design, or related intentional designs that have already healed into their environments, to see how that worked. Instead of searching connections you're searching environments. One starts with generalizing the design pattern you're working with to make it more universal. Perhaps if the design is called "bottle" you might look for the more general aspect "vessel", keeping the central object but widening the search. Those will be easier to find as recurrent patterns of design in nature, give you examples departing further from one's assumptions, and expand the selection of choices for what might be worth studying to learn from. The design pattern I've worked with that way is the universal pattern of "homes", as the structures that growth systems build as they grow, as places for their internal cultures to live. Biological homes are "cells' and "bodies', family of all sorts need them to have a place to organize their own way of living without interference, and connect with other homes. Communities and ecologies make homes for themselves with the niche's they build for themselves. Find a way to look inside most any home and you're surprised by how unfamiliar the way it works is, so it seems any home you can study shows you more about the nature of homes too. One might extend the metaphor to software too, considering any "design object" as the home for its pattern, its own unique way of arranging the internal relationships, and giving it external connections.

4.4 The challenge of observation

The biggest challenge to successfully learning from the needs living individuals, communities, networks or cultures is that no one designed them, and their own ways of working and responding to the world both were developed and remain hidden from view inside them. They are designed to work as wholes, organized from the inside, and so behave in ways of their own making. They are certainly influenced by external pressures too, but what's more important generally is how they'll react to the opportunities they come across, or new possibilities or threats they may discover.

I use these somewhat "humanized" or "animistic" terms for lack of others, and because animated systems of all kinds do have minds of their own in some sense, that present as the organization of the "forces" and "options" you have available to make satisfying patterns of design with. The opportunities living things will respond to are rarely obvious, and it's even more challenging to guess whether one discovery will touch off cascades of others, as the way natural systems often propagate and shift the balances of their environments. So just getting used to thinking about things that think and learn for themselves like that, rather than trying to model the world as determined by external pressures of linear cause and effect, is the first real challenge. Another of the unusual things to look for, important for recognizing patterns of natural design is the way all of nature relies on things that live entirely differently to thrive together. You see that as the "specialization of parts" in all complex natural and intentional design, seen in ecologies and communities as much as om industries. So for raising questions about and then recognizing patterns of naturally occurring design, here's a list of basic traits one can look for, and after a while will fall into natural patterns.

- internal organization allowing them to behave cohesively as a whole,
- change by processes of the whole, that accelerate and then decelerate
- inter-dependence between the active parts and the patterns of design that result in how they use their the environment, as "natural capital".
- emergent properties from connecting oppositely fitting parts

In their normal activity all living things are constantly learning new things, inventing new ways of living too, constantly reshaping their worlds and themselves as a matter of course. So a reason for designs missing the mark can be being too narrow in serving the need,, and not versatile in serving the universal patterns of needs for the culture being served. You can see how nature uses extremely generic designs to serve myriad purposes in how living things create their own forms of homes, a very generic solution for thriving independently.

Homes let the occupants develop their own very different ways of living. We generally find out just how differently other people live going into any home we visit.

The same is the case for every business, as well as every social network, and culture, that they all invent their quite different internal designs. In the extreme, the need for private space for locally organized ways of working extends even to passing events of all kinds, seen in how they come in "packages", so localized organization can develop. Making personal contact with others, socially, at work, with vendors, even within our families, all rely on our renewing mutual introductions each time to be welcomed to make contact across another person's private space. It's rather brief, but is as complex as a handshake too, needing a moment of privacy for the agreement to develop.

5. PATTERN RESOURCES FOR NATUAL DESIGNS

It helps to review the resources one would have for looking further into a design pattern's connections and relationships than its specific aims, exploring:

- what other things the design uses and ultimately serves,
- recognizing additional forces in the environment to respond to other than those directly concerned, and
- learn more about natural design patterns in general, and in relation to related naturally occurring patterns to study,

In the PURPLSOC paper (Henshaw 2015) there is further discussion of these learning methods and the use of natural pattern repositories. Learning to recognize alexander's 15 signs of natural design (1987) and his things to search for in urban design (2002), are good resources. Morville & Callender (2010) offer a nice general text on the use of design search patterns, covering many useful methods, though not addressing natural design repositories as focused on here.

Table 7 A 'short list' of 4 great natural pattern repositories to be familiar with:

Table 7. Four Natural Design Patterns to Learn How to Search For

1. Trails of patterns	the 'stigmergy' of nature
2. Stages of Growth	the working steps of transformation
3. Habitations	the organizational centers of life
4. Natural Language	a collected reference to naturally occurring designs

5.1 Pattern Search

A pattern in mind to search for

Fig 6. Pattern Search

When people or animals are searching for their needs, like for a familiar trail, food or satisfying their curiosities, what they actively follow seems clearly to be "patterns" that lead them on, much as if a scent attracting pheromone but stimulating a cognitive attractor, it would appear, directly. How you can tell is by recognizing the "search pattern" they use, casting about to direct their attention looking for signs of some kind of pattern fitting their current interest. For example, there is very little of that process we can observe when we see a snail's tentacles groping around for something, except that we can see they are "groping" for something, and sometimes evidently seeming to follow a recognizable kind of search pattern. When you see more active animals or people searching for things, just from noticing what kind of search pattern they're using, you can also often tell what they are looking for. I think it's because the way you search for something shows a lot of intentionality.

If you think about how often during the day we think of something to find, and form a general pattern in our minds of what we're looking for, followed by a quick or extended search to locate something particular, we find that activity fills much of our days. As soon as we have found one thing to work with we very often need to immediately turn to looking for another. As we shift our attention from one subject to another, retrieving the added information or materials needed next, we're holding some more general pattern in mind as a guide to what to search for next, for the following an trails of pattern evidence that fit the pattern we're looking for well enough to try.

The pattern search design used by Harasawa et. all. used (2014), to find illustration ideas, the group generalized the collection of strong words they themselves had used in describing a technique of emersion language learning, and then they looked around their world of experiences for interesting images to illustrate it with. Those basic steps fit the general model of pattern search very closely, first finding an idealized pattern to search for, and then cast about their experience for images that fit. All that would be needed to expand the model is to go beyond their "center words" and search for emersion experiences that produce transformative change elsewhere in nature to learn from.

It's then also making it intentional and learning to notice one's own search strategies, and recognize what patterns we are searching with, and observe the common pattern of scanning an environment for both learning from one's own habits and begin noticing others'. That develops into one of the better ways of beginning to get inside the life experience of others, enriching your capacity for empathy, I guess as well as one's capacity for misjudgment possibly too. Learning to notice the progress of search efforts by others can show you important things like what they are learning from their environment and whether their searches are getting progressively easier or harder, as signs of approaching one or another kind of turning point in their efforts. It can also open up one's ability to read natural behavioral signs.

A good group method of searching an environment for useful patterns and enriching views was developed two years ago (Henshaw 2013). It's called the 3Step method, originally intended as a guide to finding what forces there are to balance in an environment, rather than for finding how well a completed design pattern succeeds in doing that, as being suggested in this paper. The original design aims at freeing the imagination to help people identify what's happening in an environment of any kind that might influence some common ideal. That helps expose the richness of the context, the many forces in it and resources available too, so a group can identify a set of factors they might work with to create a design pattern solution. The approach could also be adapted to searching the environment for related examples of the design pattern imagined to study, where some natural pattern of organization may balance the forces naturally.

5.2 Stages of Growth

Growth as a feedforward of transforming change

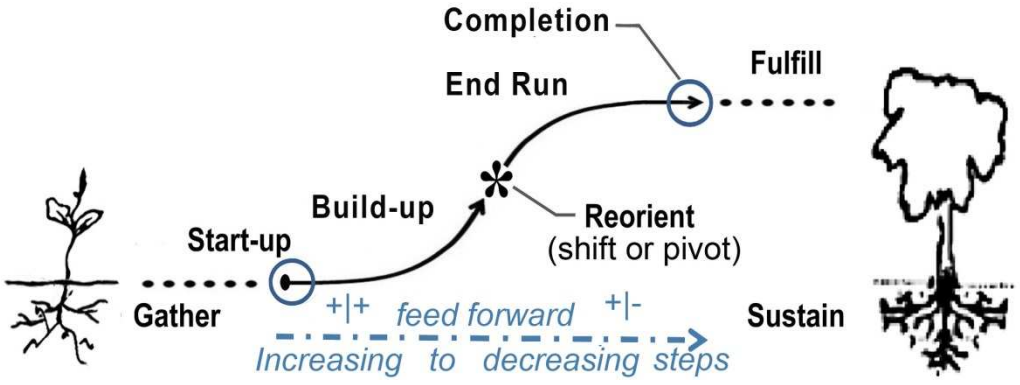


Fig 7. The stages of living system emergence

There's a natural urgency to development, going from "start-up" through "build-up" to turn the corner and "reorient", taking the "end run" to "completion. It's another of the exceptionally universal patterns. You don't want to start-up too fast, and have efforts grow spindly and fall over as seedling might, or as being much too eager in approaching other people will spoil a new friendship. These and the many other kinds of trials of the "rush of life" and the growth processes that go with it can be followed as a "continuity of stages" on the way somewhere, and used as a timeline to record and look closely how they transpire and the stages fit together.

It can be a resource for understanding the design patterns you are working on. It can be understood as a timeline of relatively urgent connections they need to make with their worlds. The model fits both the development of the design as a whole from its start-up to completion, and also the start-up to completion for the many separate connections for its parts, that are themselves growth processes that need to begin, develop and finish in order to fulfill the connection. Each growth process creates an agency on one scale using agencies on another, and it's the organization of that which takes the follow-through with small to bigger to smaller steps. At every scale something with a kind of "handshake beginning" leads to a "developed trust" in a "functional reliability" in the end, to move from possibilities to fulfillments.

So, you can study the serving if a meal order in a restaurant as a growth process, as well as the building of a restaurant. The serving of a meal starts with getting the order, and proceeds through steps of alerting the team, pulling out the stocks and preps needed, and getting them combined and then plated with all the finishing touches. It's a very complex creative sequence that "gets somewhere", invariably going through steps of first making an accumulation of bigger steps, and then an accumulation of smaller steps. It's that "accumulation" is involved that makes growth a "building process", rather than "noise", with the result relying on following steps building on preceding ones. As a general principle of design the main use is as a way to organize your observations, and study how the parts of what is really a construction process, fit together with their ascending and descending scales of steps.

For people who think more intuitively about design perhaps there are also ways to trace the same succession of changes by imagining the "urgency" of making the chain of "take-off" and "landing" steps, for a whole system of parts coming together. That sensation comes from just noticing the tangible rush of things building up as expanding resources are brought together so many things can happen at once, to deliver the product and end in an enduring calm as final steps of declining scales lead to completion at the end. Either the

intuitive or timeline record view of it gives you a mental model of the flow of transformations on which you can attach the other kinds of observations you might make.

The mathematical shapes of these classic progressive (non-linear) growth curves is what is called “exponential” (changing in proportion to their own changes) and is often said to result from first positive and then negative “feedback”. That is technically a misstatement, if talking about growth processes, where what is happening is really “feedforward”, of changes that progressively change the system producing the change. “Feedback” is technically a term originally referring to changes that restore a preceding system, the design of “self-correcting” control systems. You still need control systems to with self-correcting parts to build good relationships, but they need to be the fulfillment of satisfying non-linear growth processes that develop relationships between living cultures to actually work.

5.3 Habitations

Environments full of homes

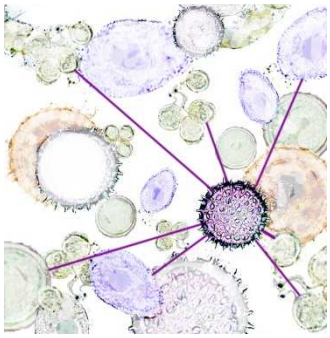


Fig 8. Homes with connections

As mentioned in the Summary of Methods and Challenge of Observation above, one of the more pervasive but seeming to be little studied design patterns of nature is creation of homes, as where living systems develop their own way of living. It takes one or another kind of 1) enclosure to separate inside and out, creating 2) a place for living things to develop their own individual way of living, and 3) serving as a center of operations for relationships outside. We also find "homes" in the form of “houses” and "dens", but also as “cells” and “bodies” when considering organisms as enclosures where the culture of cells it is made of develops its own way of working as a whole. The details of what are needed for are quite familiar to us, and they’re usually recognizable from the form of enclosure, private interior space and presence of an interior culture. A small group of friends that finds their favorite place to meet goes through the same basic steps of securing their private domain, finding where they can live the way they want, defining their own “culture”. A “community”, “business”, “society” or “ecology” does the same.

You find other kinds of habitations with different kinds of boundaries, such as the open city plan with its intense internal culture and undefined fringe. Developing an organizational

boundary, defining inside and outside to locate a common culture is also seen in the forms of "economies" and "societies", but also in the form of "professions", "disciplines" and "social networks". On smaller scales you find organizationally defined homes for independent cultures as "teams", "clubs" and "movements", all as ways of defining a space in which to develop an independent way of living. In making personal contact, the trust needed to initiate a private meeting or for the exchange of goods, acts as an arrangement to live by a common culture for a moment, and though momentary seems to fit the model of a what a home is too. Sometimes people move smoothly from participating in the culture of one home then another, sometimes definitely not. So, 'habitation' is a very common feature of how living systems work, connect and remain resilient. Recognizing one part of the pattern can lead you to others, understanding that inside is their "home knowledge" of how to live, that in most cases seem only possible to learn within the particular habitation where it develops.

For mining living quality *for* the design patterns we work on, the simplest idea is that designs work by connecting the services of one home with another. From both sides, the living quality of those connections is found in both the suitability of the intended service, and in the little things, that make each party feel at home with it, responding to their complex needs. Does the loading dock have a pull down seat, does new software have a place in it for making notes, or do online forms offer people copies of the documents they fill out? Well, it seems those inexpensive luxuries are rarely found, because the designer didn't think to suggest they might smooth the whole operation.

For mining living quality for a pattern you're working on *from* the design patterns of homes you might look to see how different parts of your serving and served networks are or might make use of the service provided. If you didn't ask the question you might not wouldn't notice that serving different communities requires differing approaches. You might find some that just find it much easier to understand what to do,… and perhaps either provide an alternate service or different guidance, or many other kinds of responses.

There is more on the nature of homes in the companion paper, too. One develops one's own way of learning about these complex relationships by "looking around", to see what patterns connect to what interests, and noticing what never seem to. As things go, as you look around and notice things that never connect with what you know, just "not in your loop", there's a good chance they're parts of some other culture.

How Alexander looked at homes, but preferred the term "centers", seems to overlap as it does here as well with the idea of "wholeness". I sometimes talk about wholeness as an

aesthetic attribute, as it seems Alexander and others often use it too. I also refer to it as quite phenomenological, as a complete organization of working relationships, defining an inside and outside by itself. From the same phenomenological view, there's no place for naturally occurring designs like that to have come from, except by developing as a whole, readily traced for most things, but hard to explain, originating from a starting pattern, a 'seed', or a hand shake, to start things off on their course. Not incidental, of course, is such physiological systems would need energy, and found to use a common way of the whole having access to energy, and the other resources.

David Seamon studied Alexander's contribution to the phenomenology of wholeness, portrayed as integrally related to other living qualities, of beauty, eloquence, good health, wellbeing, and most integrally, vitality and life (2007). All of the associations relate to things in the natural world that one can interpret by studying their parts, how they relate to other things, but not the meaning of wholeness, saying:

> "The great difficulty, however, is finding a way to move into and encounter the parts as they are in themselves so that the whole will be foreshadowed and seen, more and more fully. How do we encounter the parts most advantageously so that we can better see and understand the whole? "
>
> "Most simply, phenomenology can be defined as the careful description and interpretation of human experience. The focus is on phenomena—i.e., things or experiences as people experience those things or experiences. The aim is to describe any phenomenon in its own terms—in other words, as it is as an experience, situation, or event in the real lives of real human beings in real times and places. "

My approach to the same problem, as shown here generally, is to attribute the quality of wholeness to either the living things that begin and grow naturally as whole living things themselves, or to designs that display "fitness" in their world, by how they contribute living quality to it. That is indeed a little tricky, to think of semi-observable things that way. I've wondered, thyough, if there's any more special reason not to associate 'wholeness' with something observable, something that we need to study and learn about anyway. I suppose there must be somehow, given how that term has been set apart, and so that usage shouldn't be replaced by some other just for convenience. But that doesn't keep people from studying the various things that seem to make them feel whole, a genuine emotional state, or that serve their world in a way that seem to make it whole too.

5.4 Natural Language

Perhaps our deepest and richest repository of natural design patterns, is our own natural language. Words refer to the things of life we engage with and talk about. Our cultural associations with the words originated from those life experiences, our common words having extremely ancient roots, carried forward for thousands of years. Their meanings are continually being refreshed with new experience too. Our common words very often actually directly name the recurrent natural patterns of relationships we thought were important enough to name and attach our values to, and with the impact of words like "storm" or "mine" or "heavy". So our great familiarity with language is at the same time a great familiarity with our ancient experiences. By both naming the thing and conveying the associated values, the package of understanding of the world that comes with words can also be mined for more of the particulars of the natural patterns of relationships referred to as what we experience, a repository of designs one already knows a good bit about.

Modern people seem to have less need for understanding where the meanings of our words might have come from, of course. Our world is changing again, and requiring us to rapidly expand our understanding of how to relate to nature again, after a long period when it might have seemed we were increasingly in control. So the way language refers back to its roots in recurrent natural patterns of design will likely find fresh new use for us. It'll enable us to become more knowledgeable designers, and be more aware of the important differences in relationships that give a world the living quality our work and designs both need.

Simple and obvious examples of natural designs like "rock" as being one thing and "fire" as being quite another, or "butter" and "love" as quite different aspects of nature too. When taken out of the sentences we usually find them in their individual meanings suddenly shine through. That opens doors to our great cultural histories, letting us recall and refresh the deep meanings of our experience with the recurrent natural designs they refer to. Now that we have the tools of pattern language to work with, we can look much more deeply into those meanings than before. When we find good examples of the experience named we can recognize how the forces of the circumstance are balanced or the options at play, and better those forces in the designs for how to respond to them.

Other words like "door" or "bridge" have tremendously varied designs, meanings and uses. You might pause and searching through as many as come easily to recall the diverse images of actual and metaphorical bridges and doors and their mostly ancient roles in and meanings for our lives and cultures. What keeps apart or connects separating things, like private and public spaces or other important things, are rather complex and important

parts of life. The greatly varied use, one might note, doesn't seems to indicate indefinite meaning. It more seems to indicate the universality and varied use of a particular central meaning, as organizing principles that apply in very many contexts.

The general practice using words as a guide to recurrent designs of nature is to 1) think about a word or phrase of interest out of context first, then 2) look for the experiences and subjects associated with it, 3) examine the life circumstances and working relationships involved as a pattern 4) and identify the recurrent natural design that might include the variations, i.e. the universal part, that the word seems to be referred to. For example you might be thinking about your dog wanting to go out, and wonder about the real meaning of "leash", and come up with a new way to understand the complex service it provides as you're walking your dog. Doing just by contemplation does tend to work better for evocative words, such as Harasawa et all. (2014) referred to as "*center words*", having rich and varied associations.

To expand your ability to discover meaningful associations with natural designs from our words there would be various ways to search the web for them, sometimes literature, etc. You can also look specifically for what I'll call "*working words*", no not very evocative, but actually referring to the ways things work. One example with some feeling to it is the name of Fig 1. "Flowing connection", to name and partly describe how patterns should connect their serving and served connections. Alexander (2002) names a variety of natural design patterns with what mostly seem to be "working words" in naming his 15 principles of design. Group techniques for stimulating free association can help too. One like the 3Step method (Henshaw 2013) was designed to free the thinking of a group about what's happening in their own environment, and help them identify the active forces that would need to be responded to when designing a pattern for working with the environment for their purpose.

When you find an especially interesting recurrent pattern of design in nature this way, you can record what you found using a design pattern template. Either formally or informally, that at least documents the image and threads of connection for the future so you could go back to studying it where you left off. That's essentially what I did in developing the design pattern for "Mining Connections for Living Quality" (Table 1.). I used "living quality" as a "center word", and did various searches for its root meanings in natural language. That led me to thinking about the connections between a design and its serving and served networks, sorting through various imaginary ways living quality in the relationship might be designed for. Then I recorded the methods I seemed to find successful in finding them.

The most surprising thing is how surprisingly fruitful these methods can be even for common utilitarian words too. Simple examples might include common object names, picked at random in this case, like "road" or "hat", etc.,. Because such common words are likely among our most ancient, and have so many uses, exploring them produces more of a tapestry of meanings for the natural design they refer to, like: "hit the road" or "the road to ruin", "road to heaven" as well as "road home", "off the road", the "easy road" or the "long road" etc. Fairly quickly you get the idea we're not really talking about asphalt.

You can often speed up the process of understanding old words by looking for the root meaning common to all those and other uses, and look in an an old dictionary. When I notice that pattern of evocative uses for 'road' I looked it up in Webster's 1903 Unabridged Dictionary[4]. There you find the first two meanings: "*that on which one rides or travels*" and "*journey, or stage of a journey*". It appears the reason all those different important meanings are connected to the same humble word is that there's seems to be an important common natural design and life experience being referred to. In this case the root meaning of "road" seems to be complex, as both something that guides a travel AND requires important choices to be made along the way (Fig 9.).

Using other kinds of dictionaries would bring out other meanings, such as by searching for compound words with common roots, or common prefixes or suffixes[5]. That turns out to be a great way to discover the amazing increase in complex meanings found in western languages that emerged as Latin developed. These ways of searching for words with deep meanings associated with naturally occurring patterns in could also help expand a search for either images or good names for patterns of design being worked on, such as Hawasawa et. all. (2014) or Hamner & Mirakhorli, (2014).

[4] ARTFL online Webster's Unabridged 1903+1828 dictionary
http://machaut.uchicago.edu/?action=search&word=road&resource=Webster%27s

[5] OneLook dictionary: "states of being" in "*ence" words http://www.onelook.com/?w=*ence&scwo=1&sswo=1
road & road words http://www.onelook.com/?w=*road&ls=a http://www.onelook.com/?w=road*&ls=a

the way taken on a journey

Fig 9. The path of discovery

It can also be used to access our accumulated cultural experience with natural designs to find related living examples of design patterns to learn from. The basic strategy is to 1) generalize the pattern to find new examples for, then 2) follow the words associated with it to instances at other scales, in other places, in other uses or times. If done for finding other living examples for a design pattern you are working with, you'd start looking in similar contexts for where commonly associated words are also found used in similar ways. Then you'd look in other places, as you might looking at the forces balanced by a "bridge" while looking for naturally occurring examples of bridges displaying pattern solutions like a bridge pattern you may be working on. Any "transition" or "transformation" is a "bridge" of a kind, for example, opening up a tremendous variety of forms of bridges very particular to the environment they are found in.

One runs across these structural design connections unexpectedly sometimes, having begun a search from some starting point and following a trail of words with connecting or contrasting meanings. As you go you'd look for the naturally occurring design patterns the words refer to, mentally diagramming ones in one circumstance with the ones found in others. As discussed in Section 5.3 almost any design pattern one works on has something to do with "homes" for example, and so also with "enclosures", "separations", "breaks", "continuity", "flows", "resilience", "development", and all the many other common words associated with fairly universal terminology for the designs of natural systems, given ingenious, diverse and complex meaning in nature.

REVIEW & CONCLUSION

The paper introduced a design pattern called "Mining Connections for Living Quality" (Table 1), for using two available techniques for finding natural design patterns associated with an intentional design pattern, to check its validity and find ways to enrich it with living qualities learned from living examples of naturally occurring design:

1 Introduction

- The paper proceeds from the application to the reasons, to be more readable and allow the reader to do more thinking for themselves

2. Mining Connections for Living Quality

- The general role of patterns, designed as bridges connecting their serving and served networks of the environment is the context
- The design pattern for mining living quality for those connections is presented
    - More features and some new terminology were added for describing naturally occurring patterns of design
    - The two principle solution strategies to be demonstrated and discussed are:
        - searching in the design pattern's external connections to see how well they are served, and looking for unserved secondary needs.
        - using the pattern being worked with to look for naturally occurring examples to learn from them how thriving environments work.

3. Examples using PLoP 2014 Studies

- The method of Harasawa et. all. (2014) for developing images to illustrate patterns was presented, identifying categories of "*center words*" and drawing from them an image with "*living structure*" to illustrate the pattern
- The method by which the design pattern was illustrated for this study, (Table 1.) was discussed and compared with Harasawa's as being nearly the same,
    - The one real difference was the latter being "outward" in its search approach, looking for meaning how patterns interact with their environment, and the former more "inward", in drawing inspiration from the teams own words
- The method of Hanmer & Mirakhorli (2014) for searching software collections to find variations on programming patterns was discussed, as using a mix of computer automated search and manual review
- To add design qualities from naturally occurring design a method was loosely demonstrated

4. Background and Theory

- The need to fill a deficit in our language to discuss the non-steady state but highly organized patterns of naturally occurring design,
    - resulting from science not finding how to describe those natural designs with equations, leaving them mostly unstudied and generally undiscussed.
    - pattern language appearing suited to describe and study them, as a practice of studying the organization of working relationships from many views
- Some background on how this work and Alexander's followed independent paths having begun in the same general design community in the 60's and 70's
- The diverse and rich natural pattern repositories available, principal among them our own ancient cultures as the record for of all our knowledge of "how to live"
- The ideas of environmental search, using a generalized pattern to search for examples
    - Searching outward along connections with an environment
    - Searching globally for living examples of a pattern to learn from globally
- The challenge presented by living systems developing and acting from the inside, by means hidden from view, answered by understanding the observables
    - internal organization allowing them to behave cohesively as a whole,
    - change by processes of the whole, that accelerate and then decelerate
    - inter-dependence between the active parts and the patterns of design that result in how they use their the environment, as "natural capital".
    - emergent properties from connecting oppositely fitting parts

5. Pattern Resources for Natural Designs

- Four natural design patterns to learn how to search for
    - Trails of patterns the 'stigmergy' of nature
    - Stages of Growth the working steps of transformation
    - Habitations the organizational centers of life
    - Natural Language a collected reference to naturally occurring designs
- How to do pattern search, by using a more general pattern than you start with
- How recognizing stages of growth exposes changes in design
- The great range of kinds of homes and ways to observe their roles and changes
- The wide range in kinds of deep meaning you find in the natural relation between the words of our language and the things of nature we talk about
    - Methods of language search and root pattern discovery

ACKNOWLEDGEMENTS

I have quite a number of people, organizations and seeming coincidences to acknowledge as important to my research into naturally occurring patterns of design, being first presented with this paper and its companion for PURPLSOC this year (Henshaw 2015). Most recently was the quite valuable contribution of Christian Kohls, my working editor on the paper.

Of course I also owe a debt of gratitude for welcoming me to the pattern language community, to the PURPLSOC and PLoP organizations, and the friend that introduced me, Helene Finidori, who I met through long discussions of how to lobby the UN to take a "commons approach" as a model for our future on earth. That experience, including two years of attending UN sessions, crossing paths with various groups of fine thinkers while pushing my own learning as a very close observer, is what let me find a new mixed systems theory and social theory language. It was a surprise how smoothly it would let me find a way to use the current form of Christopher Alexander's pattern language. That it evolved to cross boundaries and spread from architecture to serving multiple professions, spreading better ways to define objects of design I am greatly indebted to.

I should also thank a small college, with a wonderful physics department, Professors Peckham and Rohmer at St. Lawrence in New York State, who encouraged my odd lab studies into how experiments always misbehave. When studying architecture at the Univ. of Pennsylvania, discovering that architecture was design for serving a world of independently behaving things certainly added to my inspiration, as well as the delight of being immersed in Lou Kahn's thinking and way of searching for deep meaning while there too. I'd also be remiss in omitting my dad, Clement L. Henshaw, whose idea of teaching physics was as a way of learning to observe what is going on around you, as well as to mention his close faculty friend, Ken Boulding who gave me great guidance when I needed it. Being from long line of science and engineering families would have been where I picked up the idea of life as a principled living system. I also had a variety of rather import personal friends, the one I really can't not mention being John A. Blackmore, who became a social scientist, and from high school on shared with me his wonderful appetite for exploring every subject on earth we could possibly think of talking about.

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