

# Some thoughts on Structuring Principles

Sally Fincher, Computing Laboratory, University of Kent at Canterbury, UK  
S.A.Fincher@ukc.ac.uk

One of the most often-cited problems of constructing a pattern language for HCI is the lack of variation within the domain. Architecture has a history of two millennia (at least) and the wealth of example from which patterns can be harvested is enormous. There are thousands of expressions of “windows” and the search for the recurrent examples of good design within that form is problematic and arduous work, certainly, requiring both critical insight and persistence, but is not hampered by a paucity of raw material. UI design is both far more recent and displays far less variety of artefact.

However, I have argued elsewhere (Fincher, 1999), (Fincher & Windsor, 2000) that the more pressing problem for HCI is the “language” that individual patterns might fit into, the structuring principle on which they are organised and the value system against which they are measured. For classificatory convenience, I refer to these two as being separate components of a pattern language, but they are clearly related and may, possibly, be the same thing.

To examine what I mean by “structuring principle” and to illustrate why I believe it to be of importance, I want to talk about some other efforts, in quite different domains, where something of the same kind can be seen.

## **A short digression into the *Engineer’s Sketchbook***

I have been quite clear that Alexander invented “patterns”, and coined the term, and for modern, practical purposes, that’s not wrong. He was the first to codify design notions into such a form. However, there are other works which, whilst they cannot be said to be part of the same genre, certainly exhibit similarities. An interesting early example is the *Engineer’s Sketchbook* (Barber, 1946), first published in 1889 (and which, going through seven editions, remained in print until the 1950s). This book was written to assist mechanical designers in their work. The author expresses his purpose thus:

“Several valuable works have already found numerous users, and there is no lack of admirable collections of memoranda, rules and data for designing and proportioning the various constructive details of machinery; but, as far as I am aware, there is no work in existence which aims at the same purpose as is attempted in the following pages, viz. to provide side by side suggestive sketches of the various methods in use for accomplishing any particular mechanical movement or work, in a form easily referred to, and devoid of needless detail and elaboration. A sketch, properly executed, is—to a practical man—worth a folio of description; and it is to such that these pages are addressed”

For the purposes of this discussion, however, it is not this striking similarity of audience, or intent, that are the most interesting. It is the way in which Barber organises the components of his work—how he defines the “language” which structures his “patterns”. He mentions this only en passant: “[my]... private notes and sketches, gathered promiscuously, until the difficulty of selection and arrangement became so apparent that I began to classify them, as they exist in the

following pages” His subsequent classification is not of whole designs, nor yet of the type of designs—Boilers, Cranes, Steam Engines, Pumps etc.—it is by reference to something that lives outside of the work entirely: to the principles of mechanics. Consequently, in the section entitled “anchors” we find not only anchors for use at sea—mushroom anchor, double fluke anchor, Martin’s patent anchor (with swivelling flukes) and rock anchor—but also fencing posts, wall eyes, a rope pulley anchor (“a car which grips by sinking its wheels into the soil; employed for ploughing tackle”) an anchor plate, a screw mooring and, even, a heavy stone. The selection and grouping of the contents of this section would be quite baffling to someone unfamiliar with the mechanical concept, which underlies them all (and which is not itself explicated in the text). The structuring principle here is *local contextualisation of principle*. Barber expects that his audience will know their context and their problems, and be able to use his work to find a good solution.

### **A short digression into poetry**

Another example of a structuring principle at work, perhaps more closely allied to a value system, can be seen in a recent anthology of poetry compiled by the UK Poet Laureate, Andrew Motion (Motion, 2001). In this work, the poems are arranged not alphabetically by author (or title); nor chronologically by when they were written, nor chronologically by when the author lived; nor categorically, by extrinsic categories discussed and agreed upon, such as “The Pre-Raphaelites”, “The War Poets” or “The Metaphysical Poets”. Here, the poems are arranged in a series of ten concentric circles: Self, Home, Town, Work, Land, Love, Travel, War, Belief and Space. This arrangement is a profound embodiment of a structuring principle. We all have meanings for these categories and most of us can find one of more poems that we should like to place within them. But use of this structuring principle carries additional significance: the act of placement of a poem (within, perhaps, Work rather than Self) speaks to the values of a specific world-view, not a generic one.

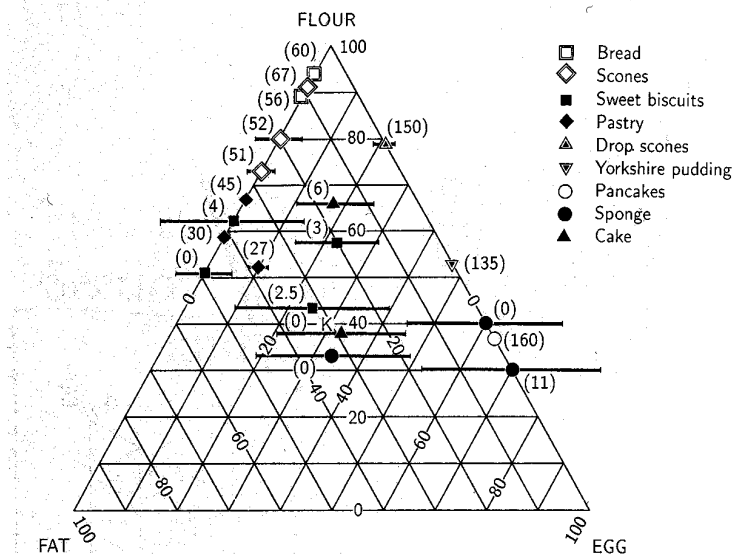
By this structure we recognise something else, too: that the placing of a poem within one of these categories is as significant as the choice of poem itself. Then it becomes apparent that the relationship between the poems within a category (and the relationship of that category to another category) is also meaningful. The act of placement within this system is not merely one of organisational convenience, of being able to “put your hand on them” when you need them again (as would be the case with an alphabetic organisation). The structuring principle here is that the *structure is as important as the components*; symbiotically, and cyclically, the one is revealed by the other.

### **Two short digressions into Chemistry**

(i) In 1894 the Newland/Mendeleev Periodic Table did not include the “noble gases”. William Ramsay was partly minded to look for Argon (and, in fact, did discover it) by noticing that there was a section in the Newland/Mendeleev table where it could fit: if it *were* to exist, there was already a place for it within the existing structure. The following year he discovered Helium, which he could also place: however, what he now had was the first and third elements of a new group. He expressed his dilemma thus “Here is a supposed gas, endowed no doubt with inert properties, and the whole world to find it in”. Spurred by recognition of this “hole”, he worked on, and identified Neon two years later (Davies, 2000)

This digression is, it might be said, written more in hope than expectation, but it could be imagined that *a strong structuring principle would be predictive*; allowing researchers to identify and seek out areas indicated by “holes” in the content.

(ii) This idea (of a predictive structuring principle) might be one that is “natural” to the field of Chemistry, and therefore chemists. It has been actualised, in a small domain, and used precisely for the purpose of seeking new areas, by Dr Ernest Lester Smith (Senior Biochemist at Glaxo Laboratories 1904-1992). He charted “bakery products” on a lattice, representing their position by the percentage proportions of fat, flour and egg in their composition (Smith, 1988). Quantity of sugar is indicated by the horizontal line, and proportion of liquid by the associated numbers – if the liquid is milk, the number appears in brackets.



Dr Smith says of his representation “Obviously it is easier to use the original recipe than the graphical diagram. Its value is to *compare* recipes within a group, and between groups, and hopefully to devise new ones.” (original emphasis).

He discusses the different properties of groups of recipes – from the exact centre of the diagram (which represents Victoria Sponge) moving out to the “flour corner”, “fat corner” or “egg corner” where the recipes tend to bread, sweet shortbread biscuits and pancakes respectively. For his purpose however, he did not regard the diagramming as a success. He concludes his article “Regretfully, there does not seem much scope for devising new types of bakery products. For example, it can be seen that somewhere between the Yorkshire pudding and rich cake formulations must lie a recipe for a soft, moist dough-cake—but that has already been invented”. The fact that Dr Smith did not succeed in his small, densely-populated, domain does not, I think, materially detract from the potential strengths of a predictive structuring principle.

### The search for invariance

I have spent time dwelling on the purpose and nature of structuring principles and value systems, and some of their manifestations and potential combinations, because in part the search for patterns in HCI has been a search for invariance. This has been both masked and made apparent by the way the activity has developed. The patterns that have been proposed have had nothing to

link them, to make them coherent. They may (or may not) each represent something good/useful/interesting, but they stand alone, or in “collections” that are collections only in as much as they have all been written by the same person or group (Tidwell, 1999), (*The Brighton Usability Collection*, 1998). Where Structuring Principles *have* been proposed, they have focussed on common physical properties of interfaces (or aggregations of physical properties) or common usages (Fincher & Windsor, 2000), (van Welie, 2001). These organisations are both arbitrary and infinitely malleable; they represent nothing but temporary convenience. They are, “a neat way to capture a bunch of good ideas” (Alexander, 1996).

Now, invariance in Alexander *does not* come from the physical expression/codification of patterns—or from the physical properties of the spaces they pertain to—but from a particular quality of the relationship between physical and psycho-social space. In the first book to be published in the area *A Pattern Approach to Interaction Design* (Borchers, 2001) the patterns are sub-divided into three areas: the application domain (in this case blues music), HCI for interactive exhibits and software engineering for interactive music software. Invariance, the call to what is “good”, is most apparent in the patterns of the application domain, where the appeal is to music-theory. As we have already seen, Thomas Walter Barber’s invariance comes from physical laws and Andrew Motion’s from a strong and certainly conceived world-view. Consequently, it would seem to be more fruitful to seek for the “invariant principle” for HCI patterns *away* from the practice that is captured in the patterns themselves.

### **What re-thinking structuring principles might mean to HCI patterns**

If the invariance for HCI Patterns might be better sought away from the artefacts that provide the sources and examples for the patterns, then what would this mean?

Perhaps the nature of the invariance might be found within the cognitive domain, separate from the physical expression of any given system. The richness of that domain might allow a deeper and more interesting exploration for the pattern endeavour.

Perhaps we would see *different* patterns emerging, because “Patterns don’t justify the values they embody; the values inform the identification of Patterns.” (Fincher & Utting, 2002). Additionally, it may be that different *relationships* between patterns would emerge, and an apprehension that the placement of a pattern along a specific dimension (or graphed as a combination of points along several axes) might be as important as the problem the pattern exemplified and the solution that it offered. (à la Andrew Motion, above).

Such a structuring principle for patterns, might allow a selection and grouping of patterns which are similar in principle, but which may be currently dispersed (à la Engineers Sketchbook, above); perhaps, even, it would allow designers to look at a less-populated area of the structure and predict what it should contain (à la Ramsay and Smith, above).

### **References**

- Alexander, C. (1996). *Patterns in Architecture*. Paper presented at the The Eleventh Annual ACM Conference on Object-Oriented Programming Systems, Languages and Applications (OOPSLA'96), San Jose, California.
- Barber, T. W. (1946). *The Engineer's Sketch-Book of Mechanical Movements, Devices, Appliances, Contrivances and Details* (7th ed.). London: E. & F. N. Spon.
- Borchers, J. (2001). *A Pattern Approach to Interaction Design*. Chichester: Wiley.

- The Brighton Usability Collection*,. (1998). Retrieved 2002, from <http://www.it.bton.ac.uk/cil/usability/patterns/>
- Davies, A. (2000). *The Chemical History of UCL*, 2002, from <http://www.chem.ucl.ac.uk/history/chemhistucl/hist13.html>
- Fincher, S. (1999). Analysis of Design: an exploration of patterns and pattern languages for pedagogy. *Journal of Computers in Mathematics and Science Teaching: Special Issue CS-ED Research*, 18(3), 331-348.
- Fincher, S., & Utting, I. (2002). *Pedagogical Patterns: their Place in the Genre*. Paper presented at the ITiCSE 2002, Aarhus, Denmark.
- Fincher, S., & Windsor, P. (2000). *Why patterns are not enough: some suggestions concerning an organising principle for patterns of UI design*. Paper presented at the CHI 2000 workshop: Pattern Languages for Interaction Design: Building Momentum, The Hague, Netherlands.
- Motion, A. (2001). *Here to Eternity*: Faber & Faber.
- Smith, E. L. (1988). The Bakery Graph. In N. Kurti & G. Kurti (Eds.), *But the Crackling is Superb: An anthology of food and drink by Fellows and Foreign Members of The Royal Society*. London: Institute of Physics Publishing.
- Tidwell, J. (1999). *Common Ground: A Pattern Language for Human-Computer Interface Design*, 2002, from [http://www.mit.edu/~jtidwell/common\\_ground.html](http://www.mit.edu/~jtidwell/common_ground.html)
- van Welie, M. (2001). *Interaction Design Patterns*, 2002, from <http://www.welie.com/patterns/index.html>