

This article is derived from issues 63 and 64 of the USIT Newsletter, which has a complete list of the USIT references. See <http://www.u-sit.net>. This is the first of a series on the interplay between intuition and logic.

## **The Intuition-Logic Struggle**

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### **Working backwards**

We learn in the USIT textbook the importance of a well-defined problem and how to produce one from a wealth of problem-situation information. This is the topic of an early USIT lecture that is easily glossed over by students eager to get on with finding solutions. After all, “We’ve heard it before!” Yes, you have. Starting with a well-defined problem is a ploy of most structured problem-solving methodologies. But too often it is not recognized as a solution-finding step. How does that work?

How does defining a problem solve it? That’s not quite what I mean. The point I want to make is that in the thought process of developing a well-defined USIT problem new insights are discovered. Each new insight instantly prompts the subconscious for intuitive solutions. We can’t help that. In fact, we want to encourage it.

Intuitive solutions are often wrong; even so they provide excellent starting points for modification and polishing to make an unacceptable concept into an acceptable one. Of course you don’t know a concept is wrong until you have consciously tested it. Then issues are discovered which seed again the subconscious. Intuitive solutions from our subconscious prime our conscious into rational thinking.

Recall that one of the solution techniques of USIT is to start with a known solution. This technique came about as an extension of the mathematics heuristic of working a problem backwards, from a solution to the initial problem. It is embodied in the particles method of ASIT and USIT, and the little people of TRIZ. Another USIT heuristic, an extension of working backwards, is to look at intuitive solution concepts as tentative solutions to be modified for possible use.

### **Reality versus logic**

In a moment we’re going to do an exercise together to demonstrate a subconscious conflict of reality and logic. I could tell you this at the end of the exercise and then have you go back and review how it happened. However, it occurred to me that it might prove

more effective to give you a clue of what to watch for as we proceed. Since it is a subconscious phenomenon, I don't think forewarning will affect the results. The logic of USIT suggests first establishing an unwanted effect. Follow this with its analysis. Then look for solution concepts. The reality is that upon recognizing an unwanted effect one's mind immediately offers intuitive solutions. It is reminiscent of the axiom, "Put a problem on the table and everyone present will instantly try to solve it".

### **Intuitive solution concepts**

To illustrate how quickly intuitive concepts come to mind I'll suggest a problem situation and slowly walk us through it. As you read, stop immediately (before you see my ideas) to write down solution concepts as they come to your mind, any intuitive ideas. These should include related problems and known products that come to mind. Of course you and I will have some of the same ideas and some different ones. There is more to be discovered in this exercise, but I'll save that until we have some ideas to work with.

*{Pause here to get a pencil and paper. Heuristic: Learn by doing.}*

The {Pause here: ...} inserts that follow show where I paused to ponder a moment. A simple way to find a problem to discuss is to pick an obvious artifact, any manmade object, and wonder how it might be improved. This could involve modifying an existing feature (incremental improvement) or adding a new one (invention). I'm typing this lecture using a computer keyboard. This could be a useful artifact. Let's give it a try. I asked myself if a keyboard could be improved? That led me to look at it to see which keys I use and don't use.

*{Pause here: Have you written any ideas yet? If not, give yourself another 30 seconds while you stare at your keyboard.}*

I noted immediately that I rarely use the numeric keypad, 20% of the length of my keyboard.

*{Pause here: Any intuitive activity yet?}*

Then I noted that I rarely use the F-keys, 40% of the width of my keyboard.

*{Pause here: Now how many ideas have you gotten?}*

Without pausing to verbalize an unwanted effect, several intuitive concepts came to my mind:

1. Make the numeric keypad thin and slide it in and out from under the main board when working on projects that need it.
2. Make the thin keypad a touch-sensitive pad.
3. Make the F-key row retractable also, to be brought out for projects that use them.
4. Replace the F-key row with a single-line display screen showing the line being typed. This would ease the distraction and avoid loss of time when stopping to find the cursor on a large screen.
5. Make a folding keyboard to hide unneeded sections.
6. Design a split, rotatable keyboard (a known product).

Now that those ideas are out of my head I can move on.

*{Pause here: Did you think of these ideas and/or others? Did these cause you to think of others? List any ideas that reading mine caused you to think of – ideas spawn ideas. Did some of your ideas spawn others?}*

7. Have the numeric keypad and/or the F-keys appear in a corner of the main screen when needed. Display and operate them using the mouse.

Pause here: (I'm momentarily out of ideas.) Was your intuition productive up to this point? How many ideas did you have? Did it occur to you that any particular ones might be worth developing further?

Our goal in this exercise is to select a problem situation and develop it into a well-defined problem. The above pauses and moments of pondering were to clear our minds of intuitive ideas without filtering them.

An unwanted effect that is nagging in the back of my mind is the computer keyboard takes up too much desk space. I'll continue with that idea. You will get more out of this exercise if you choose your own unwanted effect to work on as you read.

### **Points of contact offer phenomenological insight**

Next we need to select objects that contain the unwanted effect. Two pairs of contacting objects came to mind: keyboard and desk, and keyboard and fingers. It's convenient to group fingers as a single object. I'll look first at the keyboard-and-desk pair of objects and then consider keyboard-and-fingers. The former will clarify the functions a keyboard has; the latter will clarify its operation.

Serious analysis of a pair of objects and an unwanted effect begins at their point of contact. The phenomenology we invoke, to rationalize proposed causes and their effects, provides new insights.

### **Phenomenology**

The frame defines the footprint of my keyboard. Within the frame are individual key assemblies. The keys are arranged into several function groups; a QWERTY group with its own numbers, the F-keys, a numeric keypad group, arrow keys, Insert and Delete and 4 page-selection keys, 3 screen manipulation keys, and an isolated Esc key.

*{Pause: Any intuitive activity here?}*

8. Replace F-keys with voice activation.

9. Replace screen manipulation keys with voice activation.

10. Replace the F-row of keys with a built-in touch-sensitive cylinder of keys. Rotate the cylinder to a row of F-keys or a row of screen manipulation keys, or arrow keys, as desired. Maintain cylinder position with angularly arranged detents.

11. Replace the top row of number keys with the key cylinder (10) and let the F-row be the default position of the cylinder.

Other objects to consider are fingers that make contact with keys.

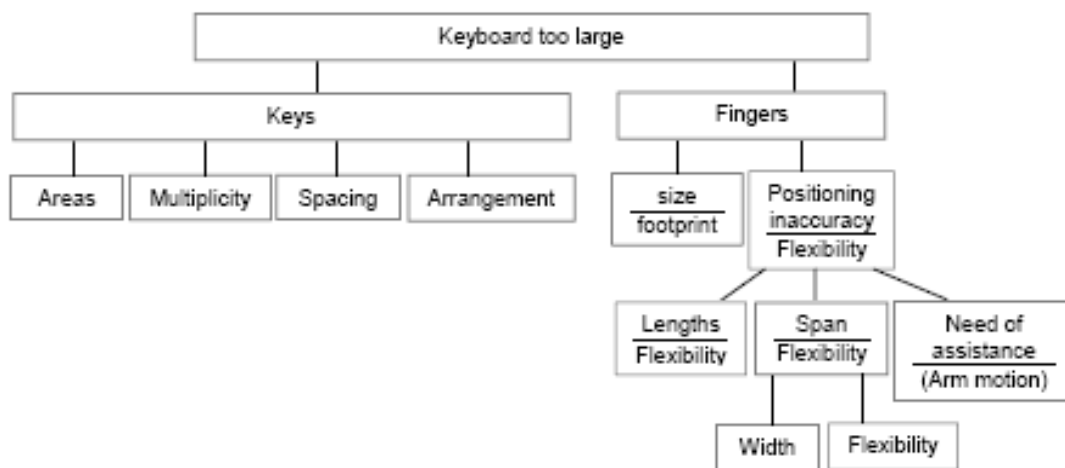
### Intuition model

It appears that subconsciously I'm using a simplified OAF model in finding intuitive concepts – no attributes are involved. This demonstrates that intuition is seeded quickly with only objects and effects. By adding attributes to our thought path we begin to subdue intuition and emphasize logic. Logic, in this instance, gives us pause to rationalize the addition of other key features in problem definition. Once this is done, intuition will again become active, as you will see.

In the exercise above we saw intuitive ideas spring from the names of three objects and an unwanted effect. Now we'll add attributes to see what happens.

### Plausible root-cause analyses for new perspectives

We can do a quick plausible, root-causes analysis at this point to see if any new ways of looking at the keyboard come to mind as we identify attributes. Choosing keys and fingers as two interacting objects was obvious, as were the causal attributes of keys shown in the diagram. The remainder of the diagram required more consideration.



After some thought, I chose finger size and positioning inaccuracy as the main causes of fingers producing the unwanted effect. Positioning inaccuracy involves three finger-attributes, longitudinal reach, angular span, and any need of assistance. Short fingers may need assistance from arm motion. Arm is inserted in parentheses to indicate that an additional object is being considered. Finger span is limited by interference of neighboring fingers as a result of their widths and finger-joint flexibility.

In the process of rationalizing the components of the diagram, thoughts came to mind about causation of flexibility. These included issues of undue stretching, fatigue, and general ease of motion. I also thought of the tactile contact with a key. However because

I have little experience with these issues I moved on. They seem to be more appropriate for ergonomics experts. Note that these ideas provide entrees for sensible discussion with an expert.

*{Pause: Any intuitive activity here?}*

The exercise caused me to examine and analyze my hand and finger positions while typing. I noticed that I rest my forearms (not elbows) on the edges of my desk as I type. Their positions introduce natural arcs in the lateral motions of my hands as my hands move over the keyboard. This made me wonder if arranging the rows of keys in arcs would assist typing accuracy – an experimental idea for the ergonomic scientists (and a keyboard idea – that may be known [?]).

12. Arrange QWERTY-rows in arcs.

Positioning inaccuracy, being related to span flexibility, raised a question of whether all keys need to be of the same width? Why couldn't keys within the easy reach of one's default hand positions be narrower?

13. Vary sizes of keys according to ease or accuracy of locating them.

I notice that, to this point, 11 ideas were found before the plausible root-causes analysis and 2 afterwards.

In my experience, construction of the plausible root-causes diagram demands associated rationalization. This leads to trial-and-error testing of causes, trial selection of wordings, and rearrangements of boxes. It is the most thought provoking exercise of USIT. Here you discover the depth of your understanding and the level at which you should be able to find solution concepts.

However, in this particular example, I got more intuitive ideas before looking for plausible root causes than during the search. That didn't used to be the case when I was first developing the tool. This is why I encouraged you to pick your own unwanted effect to investigate. That way you could discover how construction of this diagram impacts your thinking process.

### **Problems solved using USIT**

I'll digress a moment to attempt an explanation of my experience. I am occasionally asked for examples of problems solved using USIT. This question is somewhat troubling because it seems to ask what has USIT done? I have solved problems using calculus, but I can't tell you what calculus has done.

I have used USIT many times in the past years, always with success. Yet I can't claim that those problems were solved by USIT. USIT is a thinking methodology based on an assortment of heuristics. Problem-solving ideas come to mind while using these heuristics. However, heuristics are exercised at the conscious level. Solution concepts arrive to the conscious from the subconscious.

Solutions belong to their associated problem not to a methodology. In principle, they can be found by other methods. Using USIT is a way for the conscious to seed the subconscious. The subconscious does the problem solving. How? I don't know. So why did I find more ideas intuitively before exercising the plausible, root-causes heuristic? It may be that years of experience using USIT has somehow engrained in my mind unwanted effects, contact between object pairs, and causal attributes in some subconscious but effective way. This would be doing USIT at the subconscious level. It may simply be that I'm old enough to have many years of experiences for my subconscious to search through. Cognitive psychologists probably have other ways of looking at this question.

Finally, note the logic, or its lacking, in the processing of the exercise so far. I started out using USIT on the keyboard problem. While searching an unwanted effect, intuitive improvements came to mind. By the time I got to plausible, root-causes analysis more concepts had been found than would be found using the analysis. Did USIT provide these ideas? I don't think so. Did my logical, conscious mulling of USIT do it? Again, I don't think so. Solutions came from my subconscious. Conscious testing of these intuitive ideas raised more questions for the subconscious to ponder. Did you have a similar experience? Let's get back to the exercise.

### **Multiple unwanted effects**

“Keyboard too large” is one possible unwanted effect. Can a computer keyboard have others? A keyboard's electrical cord is always a nuisance, but wireless communication solves that one. Visibility is a problem with laptop keyboards on night flights. It is also an occasional problem for desktop keyboards.

#### 14. Illuminate keys.

A systematic method of searching unwanted effects is to focus on contact points of single pairs of objects. Let's have a look at a single finger contacting a single key.

*{Pause: Any intuitive activity here?}*

This brings to mind typos and their causes. I have in mind mechanical errors not mental ones. There are two mechanical errors that I experience while typing: accidentally striking two side-by-side keys simultaneously, and accidentally catching an upper row key when intending to strike the key below it.

Eye contact with key is another possible source of an unwanted effect. My typing is composed partly of unaccomplished touch-typing and partly the “biblical method” (Seek and ye shall find!). Seeking and finding requires eye-key visual contact. I have no touch-typing capability with number keys. I rarely use the numeric keypad, preferring instead to look at the upper row of number keys while typing. Thus I always position my keyboard toward my right-hand side to put the numeric keypad out of the way and more easily access the QWERTY keys.

No other unwanted effects come to mind at the moment; so let's analyze the simultaneous two-key-strikes effect. I'm distinguishing simultaneous two-key-strikes from a double-strike of a single key.

\*\*\*\*\* To be continued \*\*\*\*\*