Problem Solving Theories

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I. Meaning of problem

It occurred to me, in a moment of conscious access (to be explained later), that the title of this blog might best be introduced one word at a time beginning with the meaning of problem. Furthermore, that this is a blog on theories of problem solving for innovation and invention, it seems to require the perspective of the unusual, the unexpected, and the not so obvious. That's the perspective. The goal eventually is to understand how the brain identifies, analyzes, and solves problems – a model or theory. The strategy unfolds as follows.

Problems can occur at a point where and when one or more objects are in contact. Did I say, "… one or …?" Yes. The tongue of the object person can touch the object's nose, for example. Thus, a problem has objects, which have points of contact, time, and location. Given these conditions a problem, to be a problem, has to have an unwanted effect associated with the point of contact. This implies that effects (also called functions) are what points of contact are all about. An unwanted effect is a mal function; i.e., a problem. You can think of function as the reason for the existence of a contact in the first place; i.e., an engineer's design intent. The word function puts life into the metaphor point-of-contact.

Notice that the words object, point, contact, and function have not been defined. (See Glossary for definitions.) Here are examples of problems starting out with the need of solution concepts (as do all problems).

> A small hole in two plates in an electrolytic solution and at different potentials, regulate the amount of current flowing between them. When a blood cell passes through the hole, the rate of flow changes and a pulse of current is registered. Voilà! We have a blood-cell counter. The hole and blood cell represent a dimensional scale on the order of 10 microns (10^{-5} meters).
>
> Hole is not an object. It is an attribute of an object. Hole size, electric field strength, and induced charge on a particle regulate the current through he hole.
>
> A book resting on a table constitutes two objects in contact. The function of the table is to localize the book in space and time. The weight of the book interacts, at the point of contact, with the elasticity of the table to counteract the force of gravity that would otherwise destabilize book's location. Multiple functions and other attributes may be active at the same location with or without other objects – an opportune point of focus for innovation and invention.

So what's going on at the point of contact; i.e. what's unique about it? Gravity is not unique. It's there before, during, and after the interaction. What's happening is that the elasticity of table, an attribute of table, interacts with the weight of book, an attribute of

book, to stabilize book's location in space and time. The function (the effect) of the interaction is *to stabilize* location of book. (Note, in reverse order, object–attribute–function, OAF, more on this later.) That is what this two-object interaction was designed to accomplish.

In essence, attributes of objects at a point of contact interact to support a function that changes or stabilizes attributes of an object. Of course objects have many attributes. They distinguish otherwise similar objects form each other. However, not all of their attributes are active (in use) at a given functional contact. Here, in unused attributes, lie potential roots of innovation and invention. By design we can turn on or off attributes to achieve fixes to mal functions and creation of new functions.

> So you're walking past your desk and drop a book on it for later use. However, the book slides off and lands on the floor. That's a problem situation. Can you find a problem and solution concepts to this problem by turning on and off attributes of these objects? Begin with a point of contact. Identify objects and their active and inactive attributes at your chosen point.
> (Need help getting started? My solutions can be found on this blog at /EXAMPLES/1. BOOK SLIDING OFF TABLE.)

Once an OAF concept has been established there may be opportunities for scaling and invention.

> Consider a molecule-size hole, ca. 1 nanometer or 10,000 times smaller than a blood cell. Again add an electrolyte and a potential difference, which together produce an electrophoretic force that can move even a DNA molecule through the hole and thereby count it. (M. Muthukumar, C. Plesa, and C. Dekker, Physics Today, Aug. 2015)

We have arrived at theories of problem solving for innovation and invention.

But wait a minute! There's more to the definition of a problem than has been covered here. After all, a problem does not occur at a point of contact! (That'll give you pause after reading the above paragraphs.) A point of contact is where a problem situation becomes apparent. Ah ha! 'Becomes apparent' is getting closer to a problem, or to its starting point of realization.

When our unconscious recognizes an unwanted effect and points it out to our conscious, now we have a problem. This recognition becomes a disturbance on the brain's neural network that must be attended to instantaneously. The brain, to ascertain whether it is a threat to its homeostasis, must attend quickly to such a disturbance. If not a threat, it becomes a problem that can be dealt with in due, thoughtful time. From this conclusion we infer that a solution is anything that quells a neural net disturbance.

Beware the problem situation. Herein may hide multiple problems with complex interactions, an overwhelming mental challenge.

Current technical minds have learned how to tackle a problem situation. First it is identified in its full threatening complexity. Next it is parsed into individual problems. These are then broken down to points of contact of objects. Since we can solve only one problem at a time, the next step is to pick a single point of contact and there to minimize the number of objects to deal with, like 3, 2 or even 1 object. Here a single problem is analyzed and multiple solution concepts found using theories of problem solving – i.e., using heuristics, tricks and techniques that aid one's thinking.

Think heuristic. Then think big – everything is a heuristic.

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