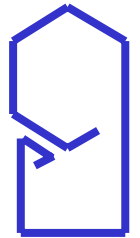# Introspection
Insight
Innovation

I3

Problem Solving for Innovation

Pre-engineering concepts – no engineering specifications, equations, or

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Introspection, the 1st word in the title, is the focal point of this talk. Introspection deals with thinking about how we think.

John B. Watson (1878-1958) ousted introspection from the science of psychology due to its subjectivity. The new research results of cognitive scientists resurrected introspection as a viable research tool.

I3 is a new problem-solving methodology that uses introspection extensively in search of pre-engineering solution concepts to innovation and invention-type problems. Pre-engineering implies no engineering specifications, no equations, and no numbers. Emphasis is on broad, unrestricted mental access to solution space.

Target audience; experienced users of structured problem-solving methodologies and newbies to structured problem solving not already biased by particular SPSMs .

I3 was developed using introspection and the bilevel model of the thinking brain.

Cognitive Scientist's Research

In Dr. Stanislas Dehaene's wonderful book 'Conscious and the Brain', I learned …

The brain does not use logic to solve problems!

This defies a lifetime of logically solving technical problems!

In the past 20 years, beginning with adopting the position that subjective responses of cognitive-science research subjects must be recorded as valid data, this field of research has seen a major revolution.

Avoiding all logic – the thesis of this talk – presents a major challenge to current logic-driven problem-solving methodologies. To meet that challenge the first problem-solving methodology to avoid the use of logic is presented here as I3.

     PSM: problem-solving methodology

     SPSM: structured PSM

If the brain uses no logic to solve problems …

Why do we spend the effort using …
logical heuristics,
logical problem–solving methods,
logical problem statements

These are restrictive, wasting time and money!

(If the statement is true.)

Heuristics are all types of devices, vocal and graphic, that aids one's brain in solving problems. These span the range from crude doodles to elaborate flow charts outlining the flow of logical thinking in problem solving.

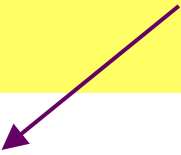# All Entities Listed Below are Heuristics

(all PSMs)

Vague problem situation –

amass information – simplify – identify multiple problems – sort them – select one – create well-defined problem statement, analyze – root causes – OAF diagrams – solution techniques – extremes – generification – dimensionality – iterate …, and iterate again …, as required.

Amassing thorough information as required for clarifying one's understanding of a problem situation. This supplements relevant information already stored in your long-term memory – this process is the same for all SPSMs.

I3 methodology preparation ends with amassing information. The rest of the above flow chart represents focus on logic that wastes time – i.e., if the brain uses no logic to solve problems (Slide 2).

The 'Pseudo Logic' of Problem-Solving

- Heuristics are mental devices that aid one's thinking in problem solving.

- All problem solving methods use them.

- They come from practice, academia, on-the-job training, personal invention, mathematics literature, etc.

But, are they logical?

What is the definition of logic?

Validation of 'Logic' Heuristics

But what does logic mean?

- • Formal guiding principles.
- • **Valid**, not irrational **reasoning**.

Two plausible validations of heuristics:

- • Anecdotal evidence, or
- • **Simulation of brain physiology?**

I prefer valid reasoning as essential to logic.

Current problem-solving heuristics are not aligned with the new discovery of how the brain thinks; they use logic-driven heuristics whose logic is that of anecdotal evidence.

As validation of reasoning I require a model of the brain to simulate brain physiology in problem solving.

The discovery that the brain does not use logic in problem solving supports a new brain-physiological bilevel model of thinking.

Cognitive Science to the Rescue

Current heuristics exist without a physiological basis since the necessary science had not been done until this century. Namely, …

1. **<u>brain imaging</u>** while thinking and

2. resurrection of **<u>introspection</u>** as a cognitive science research tool.

Brain imaging, especially fMRI (functional Magnetic Resonance Imaging), which enables a researcher to collect a subject's subjective response data in a test and then ascertain their validity independent of the subject.
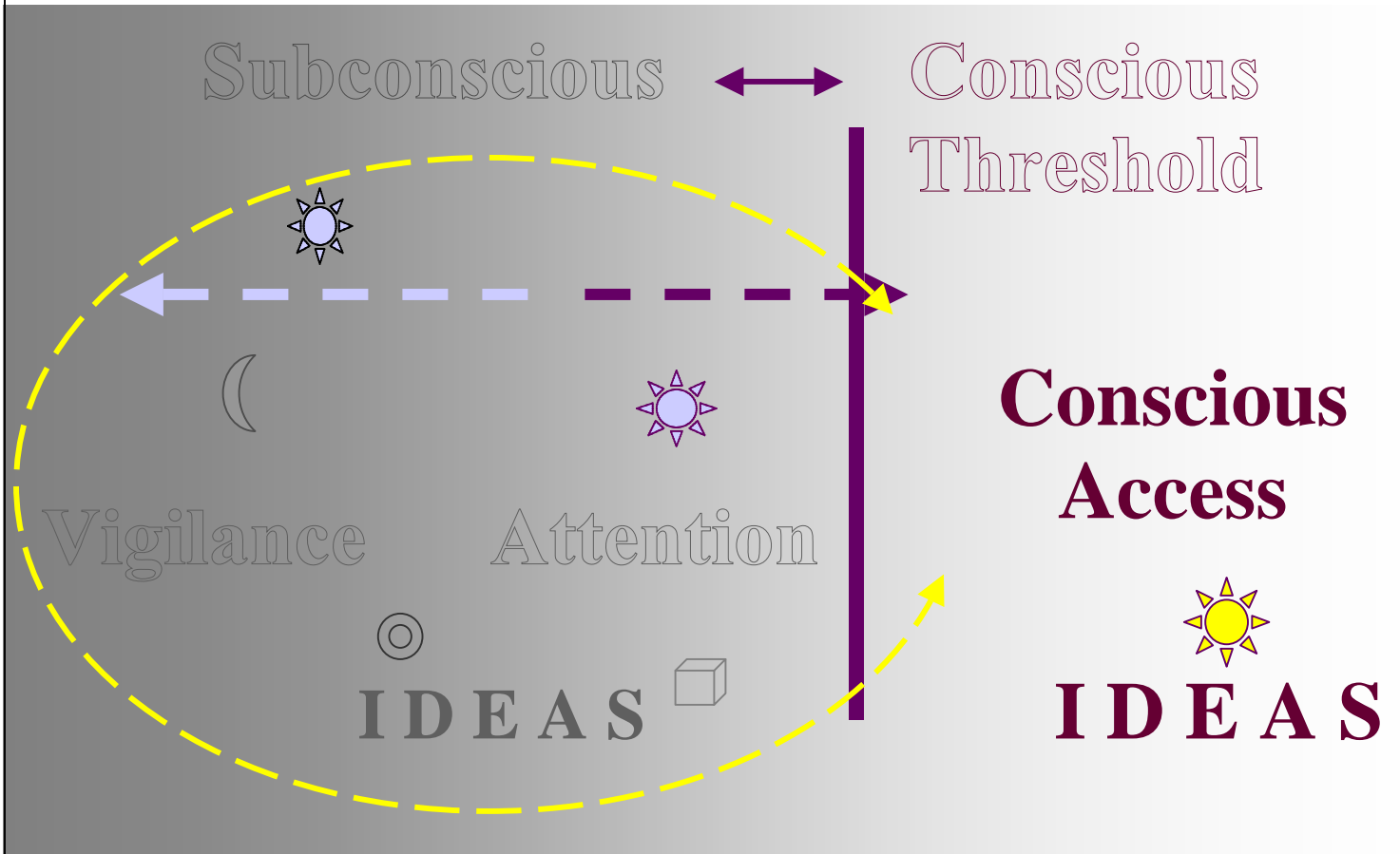
Bilevel Model

Conscious (logic)
Subconscious (intuition)

- The subconscious randomly searches memory for   relevant concepts then …

- proffers them for conscious access and voicing per rules of grammar and syntax.

- Conscious lags the subconscious; it may be busy processing other information or may not make conscious access of the new information.

Logical voicing entails conforming to normatives of grammar and syntax.
Conscious access is explained in the next slide.
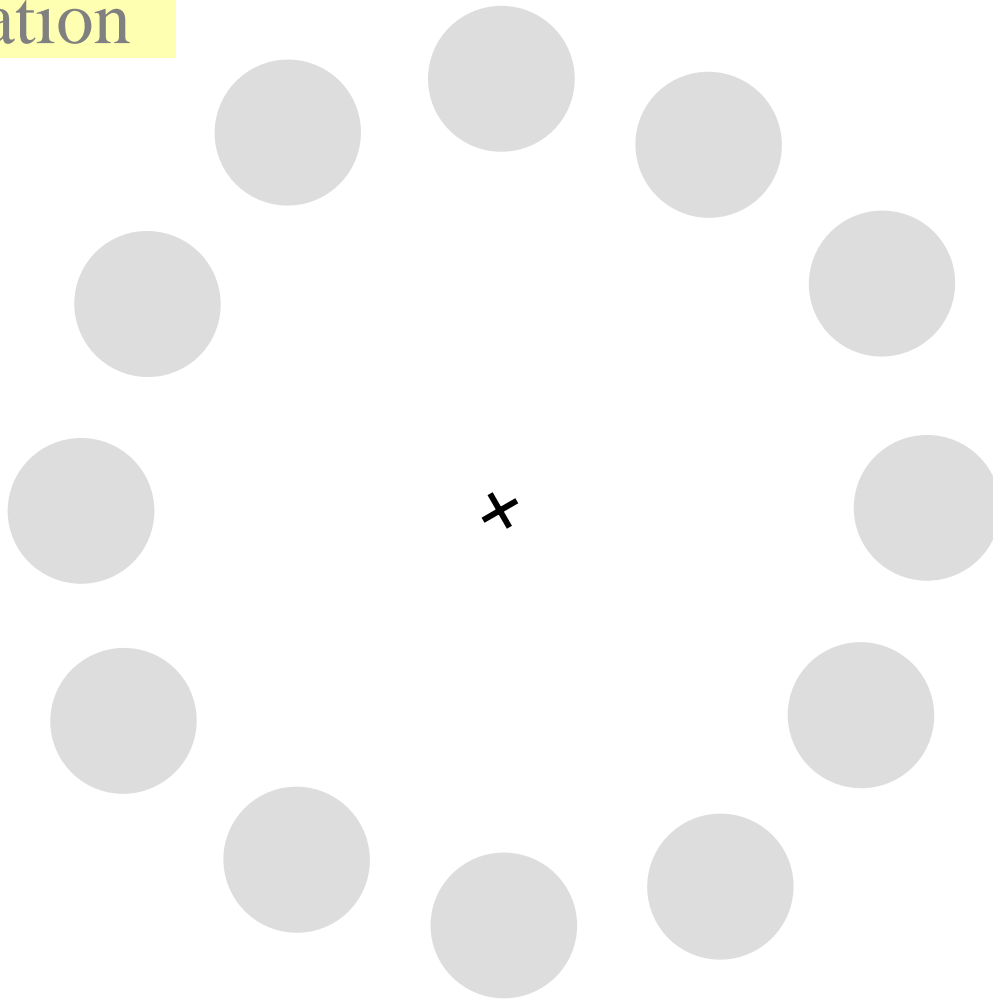
The S-C Threshold of Ideas

Attending in the S-C threshold.
Between deep sleep and wakefulness the subconscious is bonded by vigilance and attention. In this region various, random, vague and ill defined ideas seem to come and go. As the brain becomes aware of them it may decide to focus on one in particular. If focus is sustained sufficiently (i.e., being proffered to the conscious) it can pass through the subconscious-conscious threshold and become consciously accessed. The conscious now can voice it for both internal and external communication.

This slide simulates the instability of vague ideas in the S-C threshold. As you look at the image you quickly make conscious access of it. Thus all of us viewing this image can agree on its description.

Let's try it. I'll give you my description of this image to illustrate my conscious access and ask you to verify it against your now existing conscious access.

"I see a ring of 12 small grey, equal size circles surrounding a central small cross made of two black lines. The 12 circles are equally spaced from each other on the undelineated ring, and at equal distances from the central cross. The black cross and grey circles appear on a white back ground with no further contrast detail."

That's my description as voiced internally to me, and now externally to you, by my conscious access of the image. So we all agree? Good!.

Now I'll have you alter your conscious focus to just the black cross with no regard for the circles. Keep your focus on the cross and in a few seconds you will become aware of some of circles randomly disappearing and reappearing. To my mind this phenomenon simulates the instability of vague images in the S-C threshold.

This test validates the concept of instability of vague images in the S-C threshold. The phenomenon is known as Troxler's fading. See Wikipedia for more examples.

I solved it in my sleep!

We all have had the experience of awakening with the solution to a problem suddenly appearing in our minds. But ...

- Was it a full solution or an exciting tidbit?
- Did it stay with you or soon disappear?
- Can you use this method on demand?
- Have you made a viable problem-solving methodology out of it?
- Or, is it an occasional, unexpected happenstance and rarely useful?

Finding solutions in one's sleep is a common experience that does not produce an S-C threshold-type reliable problem-solving methodology

For next slide :

Metaphorical seeding using information stored in memory. I wish now to demonstrate the I3 theory of problem solving while avoiding the use of logic. Note that I am equating structured problem-solving, theory-type logic with all of the heuristics in such theories. These heuristics are a specific kind of pseudo logic.

The novelty and newness of I3 offers an unusual opportunity for falsification of this theory. Any theory to be viable must be both predictive and falsifiable. So I wish to execute a two pronged test of I3; (1) namely, to find a solution by prediction and (2) to introspect for solution concepts. Passing both of these tests establishes viability of I3 under the conditions of the current bilevel model. It is a 'Demo-Falsify' test. This task begins with trying to think of a problem to solve without using logical thoughts – so it seems at first thought. I mulled this dichotomy at some length and finally saw a way through it. I'll let the demonstration problem to be solved be, to find the problem to be solved! This self-reflexive condition offers no specific clues, only metaphoric ones – and, appropriately, I need to offer a metaphoric seed to start the subconscious search of memory. Since my C lags my S, my S knows before my C what I'm thinking about. It knows that I need a new problem – it knew that before my C did. (Continued on next slide.)

Demonstration With Falsification -- a Two Pronged Test

I propose two stringent falsification tests of the I3 theory in which …
1. my subconscious finds a problem to solve – testing prediction, while avoiding conventional heuristics,
2. then solves it for innovative ideas -- testing introspection.

Here's my strategy. Seeding of the S in problem solving has been a well established heuristic for a long time. A very common example is stepping through alphabet letter by letter when trying to recall a person's name. How the S does it is not known. That is, does a letter actually make a link in the S to a specific name? Or does it produce multiple random links and links to links? I suspect the latter. That, I presume, is why the S proffers ideas randomly and awaits the C's vetting of them for logical relevance. My reasoning being that as a result if S's randomness in searching this heuristic works sometimes and doesn't at others. Randomness goes with a lack of restrictive logic. 1st Test: I propose to take advantage of its uncertainty. I'll do that by seeding the S with the phrase 'problems I know of and have solved plus problems I simply have heard of'. With those seeds I expect my S to search randomly and encounter various candidate problems to proffer for C's logical vetting. In this way C will receive a random, previously unknown problem to be solved by I3. I'll relax and do this search in the S-C threshold. When the problem is discovered and reached conscious access, I record it and precede to the test. 2nd Test: When the 1st test has succeeded the 2nd test will

involve attending to the wording of 'the problem to be solved'. I'll go back to the S-C threshold and begin iterating the wording of the problem in my mind, with substitutions of metaphors, and avoidance of engineering specifications, until a solution is found and consciously accessed. It too will be recorded and a 2nd success declared for the Demo-Falsify test.

Note that falsification is a necessary but not sufficient condition of viability of a theory. Falsification testing is always open for future improvements as fundamental knowledge is improved.

Assumptions of the Falsification Tests
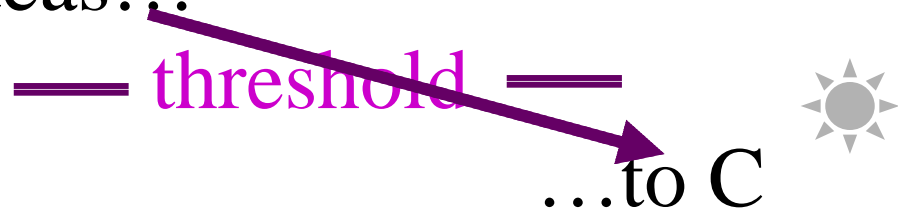
S discovers
  C voices
    Introspection monitors
      S is faster than C
S is bounded by // Vigilance-Awareness //
S proffers ideas…

— threshold —

…to C

Conscious access

Strategy (read that as assumptions)
The assumptions made in the Demo-Falsify testing are all taken from the bilevel model of thinking listed above.
S discovers a concept; C voices it; Introspection monitors the process; S is faster than C; S is bounded by vigilance and awareness enclosing the mental space where vague ideas arise; S proffers an idea to C; and if C makes conscious access of the idea a concrete, describable idea is secured.

How to execute I3 avoiding logic …

1st Think in the S–C threshold.
  (relax and 'daydream')

2nd Review randomly the problem situation.   (think metaphors – like counting sheep)

3rd Notate all ideas immediately.
  (consciously access)

I3 execution requires getting one's mind to the S-C threshold. This is as simple as daydreaming.

I3 execution involves …

1) relaxing the mind and entering a daydreaming-like mode;

2) initiate random, vague ideas by reviewing problem situation data (counting sheep);

3) awaken from the S-C threshold and notate ideas found. (Allow no filtering of ideas at this stage.)

4) iterate as desired.

1st Stringent Demo-Falsify Test of I3 – Prediction

I'll let my subconscious find a problem to solve by randomly going through problems I know of and problems I have solved to see what happens when avoiding logic.

"Breaking pencil leads; non-spilling coffee cups; personally controlled hearing aid filters; noise cancellation; malfunctioning 3-way light bulbs; automatic desktop book-binder."

☀ GOT ONE!

The Demo–Falsify test of prediction produced a string of ideas leading to a winner: 'automatic desktop book binder'.
This was a pleasant surprise when it came up. I had no previous knowledge of such an invention.
I notated the idea and preceded to the introspection test

2nd Stringent Demo-Falsify Test of I3 – Introspection

Ideas: ☀ an automatic desktop book binder; ☀ auto-sheet folder; ☀ booklet-mode printing;☀automatic gluing; ☀ auto-fold ☀ and stack; ☀ auto-align stack; ☀ press while glue dries;☀brush or ☀ spray on glue; ☀ clamp while drying; ☀ auto-trim edges of sheets to align final stack shape; – 12 ideas. QED

I got my mind into the daydreaming mode and slowly began to process the idea of 'an automatic desktop book binder'.
Ideas came quickly with some obvious randomness. The idea to press while glue dries arose before brushing glue on and spraying glue on. It struck me that logical thinking would have applied the glue and then pressed it. Such is the randomness of thinking without restrictive logic.

Brainstorming Plus I3

I3 uses brainstorming plus

three fundamental concepts:

- Orientation of the mind in the S–C threshold.

- Seeding with situation metaphors.

- Introspection to gather fresh concepts.

Brainstorming is a phase of random idea generation following, or during, a period of thinking about a problem. No heuristics are needed, although brainstorming is involved when heuristics are in use. All problem solving methodologies use brainstorming. It is the most natural, unsolicited means of problem solving.

In I3 seeding with metaphoric problem-situation description aids in orienting the mind in the S-C threshold – like counting sheep.

I3 Problem-Solving Principles

- ☀ Introspection is a viable thinking tool.
- ☀ Subconscious knows before the conscious.
- ☀ Elimination of heuristics to simulate brain physiology in thinking.
- ☀ Amass problem situation information.
- ☀ Seed subconscious with situation metaphors
- ☀ Access the subconscious-conscious threshold.
- ☀ Introspect for random ideas.

In summary, the principles employed in I3 are
Introspection for personal insights without external criticism
Subconscious knows before conscious ~ 300 msec
Elimination of the logic of heuristics to simulate brain physiology in thinking
Amassing problem situation information for focus and not using a well-defined problem statement: situation implies metaphors, statement implies specifications
Accessing the S-C threshold
Introspection for random ideas to be vetted by the C

I3: Introspection—Ideas—Innovation Problem Solving for Innovation

Ed Sickafus, Ph.D.

These slides and comments were given, in part, at the TRIZ Future Conference 2015, October 26 -- 29, Berlin Germany, (Cited in the program as 'Adaptation of Subconscious-Conscious Introspection in Solving Technical Problems').

A prequel to this paper was given (see Blog: 'Subconscious Problem Solving Using Hazy Heuristics')
and presented at the 5th International Conference on Systematic Innovation (ICSI), San Jose, CA, July 16-18, 2014.