Cognitive Tools for Trouble-Shooting Problems
NAG 1-18-2006

OVERVIEW

This is the second in a three-part "Tools for Trouble-shooting Problems" series (*NAG 9-21-2005, 1-18-2006, and 2-1-2006*). In this NAG, we will work through case studies of client/server issues at the center, using a white board and a 'thought experiment' approach.

I encourage you to read the Edgar Swift extract[1] posted to the NAG Web page (http://www.fhcrc.org/intranet/it/vox/itprof/projects/nag/) -- I will assume that you are familiar with the gist of this piece (basically, that humans make poor video cameras). I also encourage you to read Carl Sagan's Baloney Detection Kit, also posted to the Web page.

If this stuff fires you up, then consider reading Michael Schermer's more extensive Baloney Detection Kit as well as the Hy Ruchlis text; drop me e-mail if you would like me to send you copies via intercampus mail.

PROCESS

Format

For each case study, I'll describe how the issue was brought to my attention and then throw the floor open, soliciting models for understanding the situation, hypotheses for what might be causing the problem, and experiments for how to analyze the problem further. As a group, we'll pick which data-collecting experiments to implement, we'll imagine that we've performed those steps, and I'll report the results. And we'll keep going. As we go, we'll refer to the Baloney Detection Kit. And once we've "resolved" the problem, we'll review the Baloney Detection Kit again, noticing where we got lost in the woods and which Baloney Detection tool would have helped us return to the trail.

Scientific Method

This is a term for a grab bag of techniques which help us to identify the root cause of an event. Here is the process which I will be pushing:

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[1] <u>Psychology and the Day's Work</u> by Edgar J. Swift, Charles Scribner's Sons, 1923, pp. 290 - 303, pp. 306 - 308.

Formal	Informal
Describe the *observation*	Use the five senses
Develop a *model* which represents reality	Draw a picture
Sketch a *hypothesis*	Speculate
Implement an *experiment* testing the hypothesis	Reality check
Revise the model and/or the hypothesis to account for the new data	Speculate some more
Iterate until the observations from the experiments are consistent with the model and the hypothesis	This is hard work!
Promote the hypothesis to the status of a *theory*	The answer … at least for now

Observation is the final court of appeal: scientists hail from Missouri, the "Show Me" state.

Potholes

Separate observation from interpretation: this turns out to be really, really hard to do. Focus on "what the video camera would see" when you are producing observations … the video camera can't see "slow" for instance … though it can see "five seconds between click of mouse and change in screen display".

Realize that science does not converge on the truth; rather, science converges on consistency.
- For years, we thought that attaching leeches to sick people helped make them better. After gathering sufficient data (and upgrading our model for what causes disease), we realized that we were wrong.
- Later, we thought that disease was caused by *miasmas*, invisible gases which tended to collect in 'low' spots. This model rather accurately predicted the prevalence of cholera in sections of London … however, after many years of probing, we realized that we were wrong on this one, too.
- Still, later we thought that enlarged thymus glands contributed to disease … resulting in many people being treated with radiation doses to reduce the size of their thymus (back then, we also didn't know that mutagenic radiation increased one's risk of cancer). Again, further research uncovered flaws in this theory.
- From the mid-1860s through the early 20th century, we developed the *germ theory of disease* … a model which currently holds sway … although greatly modified in recent years to include non-germ caused disease. Anyone want to try predicting how our thinking will evolve further? How about this one, from the WHI Project:
- For years we thought that combined hormone replacement therapy's benefits outweighed its drawbacks. In July 2002, the WHI project produced results which contradicted this view, and many women re-evaluated their use of hormone replacement treatments.[2]

The best science can do for us is to produce a *theory* which *consistently* predicts the outcome of *experiments*. Science does not guarantee that the theory is actually correct … merely that it has,

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[2] http://www.fhcrc.org/about/ne/news/2002/07/09/whi.html

to date, predicted results consistently. As soon as a new experiment produces inconsistent results[3], we as scientists must reconsider our theory and start searching for a new hypothesis. The strongest assurance that we, as scientists, can offer is *temporary agreement*, meaning that we temporarily agree with the current theory … and when we discover conflicting evidence, we must, as scientists, withdraw our temporary agreement and probe more deeply.[4]

Realizing that science and truth have little if anything to do with each other generates anxiety in humans.   Be on the look-out for how you attempt to meet your needs for comfort, peace, and stability. Some of these strategies show up in the Baloney Detection Kits. During our time together, we will try to identify these strategies as we deploy them … be prepared for a little personal embarrassment, as we catch each other falling into these mental potholes.

Doubt is not a pleasant condition, but certainty is an absurd one. --Voltaire

CASE STUDIES

[I'm soliciting case studies … if you have one, please drop me a note.]

- When the firewalls broke over the weekend, my backups failed.

- Outlook clients whose home directories have been moved to the new NAS box are now unable to open their PST files.

- PCs in the Arnold Building are unable to acquire DHCP addresses.

- After changing from /24 subnetting to /23 subnetting, PC logon time became slow.

- Video-Teleconferencing sessions from both the SCCA and the Hutch are disconnecting both randomly and frequently.

- The network is slow because of broadcast storms.

- My e-mail client is slow; I use Hydra for my e-mail server. What is going on?

- If the network between my client and my server is almost all Gigabit Ethernet (with only a few feet of Fast Ethernet), why don't I see gigabit performance?

- DMZ Rebuild: Hutch/Internet connectivity breaks down even though no changes are being made

- DMZ Rebuild: Hutch/SCCA lose touch with each other after half an hour.

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[3] Reliably, from multiple sources -- see the Baloney Detection Kits for details.

[4] Naturally, as humans, rather than as scientists, we may cling to the discredited theory stubbornly, ignoring the accumulating evidence against it … but that's part of being human!

FURTHER READING

My reading of <u>The Demon-Haunted World</u> by Carl Sagan inspired this seminar, and I acquired additional insights from Hy Ruchlis' <u>Clear Thinking: A Practical Introduction</u>.