

Making Your Case in a Scientific Environment

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CURRENT EVENTS

- Guest Wireless Fast Track in production
- Gigabit to the desktop in some locations
- Marconi (and Guest Wireless) support for Vista
- March 21 NAG offering tools for working more effectively with your colleagues. Bob Robbins will facilitate. I encourage you to complete a Keirsey Temperament Sorter prior to the event (see NAG Web page).

OVERVIEW

Credible explanations grow from the combined testimony of 3 more or less independent, mutually reinforcing sources -- explanatory theory, empirical evidence, and rejection of competing alternative explanations.

Edward Tufte

In this presentation, I will offer my tips for making your case in a scientific environment. I'm hoping that these tips apply to a range of situations at the Center, not only working with your clients on the scientific side but also when working with your colleagues here in the IT community.

In doing this, I will be drawing from my own 25 years of experience living and working in research environments (SAIC, Cornell University, Cornell Medical College/New York Hospital, FHCRC).

I will draw from Edward Tufte (<http://www.edwardtufte.com>) critical thinking and visual analysis work.

I will draw from David Keirsey's (<http://www.keirsey.com>) temperament work, which is based on the Myers-Briggs model. I'm not a fan of personality sorting – the explanatory theory behind it sounds like gobbledygook to my ears, and I haven't seen a way to measure the results which satisfies me – however, I'm using it until I find a better tool. Keirsey slots people into four categories: Artisan, Guardian, Idealist, and Rational. According to Keirsey's model, somewhere between 80 and 90 percent of the population fall into those first two categories. However, I claim that research environments are dominated by the Rational mind-set. Members of one personality type will make instinctive predictions about how members of another personality type will react ... and those predictions will be wrong. This is where I see Keirsey's work as useful – helping me to bridge that instinctual gap

Briefly, I claim that, in scientific environments:

Evidence is beautiful. Present your evidence, and let it argue your case for you.

OUTLINE

Rational science treats its credit notes as always redeemable on demand, while non-rational authoritarianism regards the demand for the redemption of its paper as a disloyal lack of faith.

Morris Cohen

Scientists most commonly slot as a Rationals in the Keirse model, or as INTJ (Introverted iNtuitive Thinking Judging) or INTP (Perceiving) on the Myers-Briggs scale. While common in research environments, these types are decidedly uncommon in the general population. For someone who is familiar with operating in the general society, stepping into a Rational-dominated environment can be a shock. Rational cultures don't function the way the larger society does.

In the scientific mindset, questioning is always OK. Sure, scientists make assumptions and act on them ... but returning to the beginning and raising doubt is normal operating practice. The Rational mind-set is deeply skeptical ... not only of what other people say but of what the Rational him or herself says. Rationals believe that their own cognitive processes are susceptible to error, this matters to Rationals, and they invest continual effort into double and triple checking their thought processes.

And when you talk with them, they do the same with what you are saying: evaluating, analyzing, considering. The Rational mindset does not put importance on the relationship between people – hierarchy in an organizational chart, reputed authority in a field, credentials and degrees – these do not weigh on the mind of a Rational. Rather, the Rational's own analysis of your content, that is what matters and that is what will drive their decisions.

In contrast, Guardians are oriented toward hierarchy – how does the speaker relate to me, in terms of social structure? Does she have rank? (“The CEO says ...”), does he have authority? (“World renowned expert in ...”), does she have degrees? (“The doctor says ...”). Idealists are oriented toward relationship: am I in harmony with this person? And Artisans are more concerned about whether or not “it works” than with accuracy and correctness (Rational) or the social structure between themselves and speaker (Guardian) or harmony (Idealist).¹

Turning on a dime and changing one's position by 180 degrees is also normal practice for a Rational. Why? Because, in this mind-set, new data requires re-evaluation, and re-evaluation may lead to tossing out the old position and adopting a new one, sometimes done in the blink of an eye – a trademark of the 'iNtuition' personality types. This can be confusing to people who process in more methodical ways. Similarly, this can be confusing to mind-sets which are oriented toward loyalty, group cohesiveness, or steadfastness. The scientific mind-set is focused on an internally consistent story supported by evidence, not on belonging to the group, not on being a team player, and not on making a splash right now. To someone entering this environment, s/he can perceive scientists as “always right” in the most annoying way. To the scientist of course, the newcomer can appear as “always wrong”, i.e. sticking to his or her guns even when the evidence shows otherwise.

¹ I oversimplify the Keirse model here.

THREE CHUNKS

Provide Context

The scientific mind-set concerns itself with the larger picture, with how this puzzle piece fits in the larger whole. And it prizes consistency. Science does not converge on truth; rather, it converges on consistency: repeatable results. Place your page of the story into the larger context. And walk your arguments step by step, checking that each one follows from the previous one.

Provide Data

Stories are good ... but without data, they become fiction, and scientists don't waste their time on fiction. Inevitably, the scientist asks the question: *Compared to what?* Find ways to measure your story, compare it to other stories, and provide the results.

Tell Multiple Stories

Reality is a rich, complex place, and knowing the 'truth' is impossible, to the scientific way of thinking. There are always multiple ways to look at a problem and multiple solutions for solving it. As time progresses and we learn more about a subject, we discard past theories and create new ones. Present each of today's leading solutions to the problem you are trying to solve, with their strengths and their weaknesses.

TIPS

Present a range of options

The world is a richly complex environment. As a result, there are always multiple paths to walk, multiple responses to a given decision, multiple solutions to a problem. Find them – in particular, find the ways which are commonly employed ... and find the ones which are optimized to meet various needs amongst your audience ... and find the ones which attempt to meet a range of needs. Outline the pros and cons of each one. Offer tools for comparing the costs and benefits of each approach. Emotionally and mentally, put yourself behind each option and argue its case rigorously – each of these options is a viable solution.

Document Your Sources

Give your audience a chance to check your story. When you refer to a standard, include a link to the relevant place where your audience can read the standard for themselves. When you present summarized data, provide a link to your raw numbers, so that your audience can crunch them on

their own, if they wish. If you include extracts from other documents, include pointers to the original.²

Include All Your Data

Some of your data will support your story, and some will not. How can it be otherwise? The world is a complex place; you will not likely be able to account for all the influences on your results. Include the results of your tests which contradict your story – this is part of the total picture. Sketch also what you did not do: the tests you could have performed, the options you could have explored -- but did not, due to time or resource constraints.

Respect Your Audience

Your goal is not to manipulate your audience into believing what you want and thus into making whatever mistakes you are making. Your goal is to present the evidence, and let your audience reason through it in their own ways. If your favorite solution does indeed offer the optimum balance between cost and benefit, then your audience will see this, as they go through their own reasoning process. If your favorite solution does not fit the bill as well as another; then your audience will help you to see this, and the resulting solution will be the stronger for it.

Respect Yourself

When you make a mistake, acknowledge it, describe how you made it, describe what you did or plan to do to fix it, and move on. No need to hide it, and no need to abase yourself over it.

Give Away Your Material

Give your audience access to your material before your presentation ... ideally days or weeks before. Hand them a copy when they arrive to your presentation. Make sure they know how to find your material should they lose the copy you just gave them. Scientists specialize in consuming and processing volumes of information *alone* – play to their strengths.

HOW TO SHOOT YOURSELF IN THE FOOT

[For an entire text discussing such tactics, read Robert Cialdini's [Influence: Science and Practice](#). Cialdini is a professor at Arizona State who specializes in deconstructing marketing techniques and developing defenses against them.]

² If you are writing fiction, of course, you don't have to do this – your audience assumes that you made it up. Claims made without citing sources bear a striking resemblance to fiction ... don't go there.

Fudge Your Data

Every group has an idea of the absolute worst sin you can commit ... in science, the worst sin you can commit is to fudge your data, either to support your case or to discredit the other person's case. Don't do it.

Shade Your Case

Emphasize the pros, de-emphasize the cons. Omit key points which aren't favorable to your pet position. Inflate the downsides of an opposing point of view. At best, the scientific mindset considers this sloppy; at worst, manipulative.³

Deny Error

If what you are doing has any complexity at all, you will make mistakes in your analysis. When you discover these, whether on your own or through the prodding of your audience, denying them, attempting to hide them, or simply avoiding discussion of them is a fast and effective way to flag your testimony as unreliable, in the eyes of a Rational listener.

Rely on Expert Recommendations

Rely on recommendations from experts or authority figures, especially without content: "Our vendor contact, Bob Smith, recommends ...", "Doctor So and So says ..." De-personalized sources are particularly unconvincing: "Microsoft recommends ...", "Technical support recommends ...", "Experts say ...", "All the people I've asked have said ...", "The industry ...", "Best practices are ..."

This is a particularly difficult tactic to avoid, [alert: I'm headed deep into my own belief systems here ... bring out your salt.] partly because many elements in our society employ it and partly because it *works*. Humans are social animals and are wired to function in groups – harmonizing with what other humans are doing makes sense, on a gut-level. People who work in marketing, sales, politics, law employ this tactic – we're all exposed to it, we run the risk of coming to believe that this approach is normal and acceptable. However, one of the strengths of the scientific mind-set is its ability to see past what the average person takes for granted ... the *skeptical* mindset ... after all, science is about exploring unknown territory. According to this mind-set, experts have been wrong in the past ("Two out of three doctors smoke Camel ..."), they will be wrong again in the future ... people who quote experts are abdicating their right to think for themselves, so this line of thinking goes, and are thus vulnerable to common misperceptions. People who quote abstract experts (Microsoft, 'tech support', the 'industry') have given up their own autonomy and are now merely tools parroting someone else's agenda.

My suggestion: don't bother with recommendations. Leave them out. If your audience asks what your vendor recommends, report your understanding of what your vendor recommends ... but don't make that recommendation part of your presentation.⁴

³ Notice how this behavior is expected, normal practice in some field, e.g., law, politics, sales. People embedded in such cultures typically experience shock when they jump into a Rational environment and try to swim.

Present Only One Option

The world is a big, complex place, there are many ways to solve a particular problem. Presenting a single option is a red flag for anyone who lives rationally, a flag which says “This person is missing the larger picture.”

List Only the Benefits

All choices involve pros and cons, all choices involve trade-offs – this is a side-effect of reality. If you can’t see the downsides to your proposal, then you haven’t investigated enough. If you are suppressing the downsides to your proposal, then you are deep into a corrupted reasoning process of your own.

BEWARE OF PITCHING

Once you enter into a mind-set of pitching your audience, in an effort at persuading them to see things your way, you’ve taken a step down a path which leads to the corruption of reasoning, because at this point, you’re taking the stance “I’m right: what can I do to show people this?” Your mistake was in those first two words. What if you’re wrong? What if you’re wrong, but you’re good at manipulating other people? You will have successfully persuaded yourself, and others, to do the wrong thing -- hardly something to be proud of. The world is a complex place; in all likelihood, while your idea may be superior to the current contenders, it is unlikely to be the last word. Keep the possibility of ‘error’ present.

Notice how many aspects of popular culture take the opposite stance. The attorney starts with “My client is right”, the marketing person starts with “Our product is the best”, the sales person with “Buy this from me”, the politician with “Vote for me” ... and then they reason backward, to figure out what to tell you in order to attain their goal. This is a version of “I know the answer, now just let me figure out how to persuade other people that I’m right.” You are now well on your way toward bamboozling yourself.

In my experience, science types are either ignorant of pitching ... they filter out your biases unconsciously, so it ends up being a waste of your time ... or they pick up on it, figure that you’re trying to manipulate them, and discard what you say.

The first principle is that you must not fool yourself -- and you are the easiest person to fool.

Richard Feynman

⁴ If you find this hard to swallow, then include the recommendation, *but directly thereafter include the theory and the evidence which your expert offers when making this recommendation*. You may find that your expert has not, in fact, offered support for his/her recommendation ... in which case, I return to my claim: don’t include it.

WHY THIS IS HARD

The scientific process emphasizes transparency, in an effort to allow the consumer of the information to see through the biases of the presenter.⁵ In my experience, humans tend to hide their processes, rather than expose them, for all sorts of understandable, even valid, reasons. Here are a few.⁶

Concern for self-image

We fear that if different brains look at our data that they will draw different conclusions, casting doubt on our competence.

Protection against misinterpretation

We fear that politically motivated brains will consciously or unconsciously misinterpret our data.

Lack of skill or time

We don't have the skill, or we haven't figured out how to allocate the time, to present our data in an easily digestible format.

These are decidedly real concerns. But I return to my central claim: the Rational mind-set believes that transparency, and the influence of other Rationals, is the answer to these concerns and will be suspicious of your integrity if you behave otherwise.

For a successful technology, reality must take precedence over public relations, for Nature cannot be fooled.

Richard Feynman

APPENDIX

INTJ

<http://www.personalitypage.com/INTJ.html>

Portrait of an INTJ - Introverted iNtuitive Thinking Judging (Introverted Intuition with Extraverted Thinking) The Scientist

As an INTJ, your primary mode of living is focused internally, where you take things in primarily via your intuition. Your secondary mode is external, where you deal with things rationally and logically.

INTJs live in the world of ideas and strategic planning. They value intelligence, knowledge, and competence, and typically have high standards in these regards, which they continuously strive to fulfill. To a somewhat lesser extent, they have similar expectations of others.

⁵ Recall the Rational mind-set: believing that his or her own thinking processes are suspect to corruption.

⁶ Derived from "A Fair Share", *Nature*, Vol. 444, Issue #7120, p. 653.

With Introverted Intuition dominating their personality, INTJs focus their energy on observing the world, and generating ideas and possibilities. Their mind constantly gathers information and makes associations about it. They are tremendously insightful and usually are very quick to understand new ideas. However, their primary interest is not understanding a concept, but rather applying that concept in a useful way. Unlike the INTP, they do not follow an idea as far as they possibly can, seeking only to understand it fully. INTJs are driven to come to conclusions about ideas. Their need for closure and organization usually requires that they take some action.

INTJ's tremendous value and need for systems and organization, combined with their natural insightfulness, makes them excellent scientists. An INTJ scientist gives a gift to society by putting their ideas into a useful form for others to follow. It is not easy for the INTJ to express their internal images, insights, and abstractions. The internal form of the INTJ's thoughts and concepts is highly individualized, and is not readily translatable into a form that others will understand. However, the INTJ is driven to translate their ideas into a plan or system that is usually readily explainable, rather than to do a direct translation of their thoughts. They usually don't see the value of a direct transaction, and will also have difficulty expressing their ideas, which are non-linear. However, their extreme respect of knowledge and intelligence will motivate them to explain themselves to another person who they feel is deserving of the effort.

INTJs are natural leaders, although they usually choose to remain in the background until they see a real need to take over the lead. When they are in leadership roles, they are quite effective, because they are able to objectively see the reality of a situation, and are adaptable enough to change things which aren't working well. They are the supreme strategists - always scanning available ideas and concepts and weighing them against their current strategy, to plan for every conceivable contingency.

INTJs spend a lot of time inside their own minds, and may have little interest in the other people's thoughts or feelings. Unless their Feeling side is developed, they may have problems giving other people the level of intimacy that is needed. Unless their Sensing side is developed, they may have a tendency to ignore details which are necessary for implementing their ideas.

The INTJ's interest in dealing with the world is to make decisions, express judgments, and put everything that they encounter into an understandable and rational system. Consequently, they are quick to express judgments. Often they have very evolved intuitions, and are convinced that they are right about things. Unless they complement their intuitive understanding with a well-developed ability to express their insights, they may find themselves frequently misunderstood. In these cases, INTJs tend to blame misunderstandings on the limitations of the other party, rather than on their own difficulty in expressing themselves. This tendency may cause the INTJ to dismiss others input too quickly, and to become generally arrogant and elitist.

INTJs are ambitious, self-confident, deliberate, long-range thinkers. Many INTJs end up in engineering or scientific pursuits, although some find enough challenge within the business world in areas which involve organizing and strategic planning. They dislike messiness and inefficiency, and anything that is muddled or unclear. They value clarity and efficiency, and will put enormous amounts of energy and time into consolidating their insights into structured patterns.

Other people may have a difficult time understanding an INTJ. They may see them as aloof and reserved. Indeed, the INTJ is not overly demonstrative of their affections, and is likely to not give as much praise or positive support as others may need or desire. That doesn't mean that he or she doesn't truly have affection or regard for others, they simply do not typically feel the need to express it. Others may falsely perceive the INTJ as being rigid and set in their ways. Nothing could be further from the truth, because the INTJ is committed to always finding the objective best strategy to implement their ideas. The INTJ is usually quite open to hearing an alternative way of doing something.

When under a great deal of stress, the INTJ may become obsessed with mindless repetitive, Sensate activities, such as over-drinking. They may also tend to become absorbed with minutia and details that they would not normally consider important to their overall goal.

INTJs need to remember to express themselves sufficiently, so as to avoid difficulties with people misunderstandings. In the absence of properly developing their communication abilities, they may become abrupt and short with people, and isolationists.

INTJs have a tremendous amount of ability to accomplish great things. They have insight into the Big Picture, and are driven to synthesize their concepts into solid plans of action. Their reasoning skills gives them the means to accomplish that. INTJs are most always highly competent people, and will not have a problem meeting their career or education goals. They have the capability to make great strides in these arenas. On a personal level, the INTJ who practices tolerances and puts effort into effectively communicating their insights to others has everything in his or her power to lead a rich and rewarding life.

INTP

<http://www.personalitypage.com/INTP.html>

Portrait of an INTP - Introverted iNtuitive Thinking Perceiving (Introverted Thinking with Extraverted Intuition)

The Thinker

As an INTP, your primary mode of living is focused internally, where you deal with things rationally and logically. Your secondary mode is external, where you take things in primarily via your intuition.

INTPs live in the world of theoretical possibilities. They see everything in terms of how it could be improved, or what it could be turned into. They live primarily inside their own minds, having the ability to analyze difficult problems, identify patterns, and come up with logical explanations. They seek clarity in everything, and are therefore driven to build knowledge. They are the "absent-minded professors", who highly value intelligence and the ability to apply logic to theories to find solutions. They typically are so strongly driven to turn problems into logical explanations, that they live much of their lives within their own heads, and may not place as much importance or value on the external world. Their natural drive to turn theories into concrete understanding may turn into a feeling of personal responsibility to solve theoretical problems, and help society move towards a higher understanding.

INTPs value knowledge above all else. Their minds are constantly working to generate new theories, or to prove or disprove existing theories. They approach problems and theories with enthusiasm and skepticism, ignoring existing rules and opinions and defining their own approach to the resolution. They seek patterns and logical explanations for anything that interests them. They're usually extremely bright, and able to be objectively critical in their analysis. They love new ideas, and become very excited over abstractions and theories. They love to discuss these concepts with others. They may seem "dreamy" and distant to others, because they spend a lot of time inside their minds musing over theories. They hate to work on routine things - they would much prefer to build complex theoretical solutions, and leave the implementation of the system to others. They are intensely interested in theory, and will put forth tremendous amounts of time and energy into finding a solution to a problem with has piqued their interest.

INTPs do not like to lead or control people. They're very tolerant and flexible in most situations, unless one of their firmly held beliefs has been violated or challenged, in which case they may take a very rigid stance. The INTP is likely to be very shy when it comes to meeting new people. On the other hand, the INTP is very self-confident and gregarious around people they know well, or when discussing theories which they fully understand.

The INTP has no understanding or value for decisions made on the basis of personal subjectivity or feelings. They strive constantly to achieve logical conclusions to problems, and don't understand the importance or relevance of applying subjective emotional considerations to decisions. For this reason, INTPs are usually not in-tune with how people are feeling, and are not naturally well-equipped to meet the emotional needs of others.

The INTP may have a problem with self-aggrandizement and social rebellion, which will interfere with their creative potential. Since their Feeling side is their least developed trait, the INTP may have difficulty giving the warmth and support that is sometimes necessary in intimate relationships. If the INTP doesn't realize the value of attending to other people's feelings, he or she may become overly critical and sarcastic with others. If the INTP is not able to find a place for themselves which supports the use of their strongest abilities, they may become generally negative and cynical. If the INTP has not developed their Sensing side sufficiently, they may become unaware of their environment, and exhibit weakness in performing maintenance-type tasks, such as bill-paying and dressing appropriately.

For the INTP, it is extremely important that ideas and facts are expressed correctly and succinctly. They are likely to express themselves in what they believe to be absolute truths. Sometimes, their well thought-out understanding of an idea is not easily understandable by others, but the INTP is not naturally likely to tailor the truth so as to explain it in an understandable way to others. The INTP may be prone to abandoning a project once they have figured it out, moving on to the next thing. It's important that the INTP place importance on expressing their developed theories in understandable ways. In the end, an amazing discovery means nothing if you are the only person who understands it.

The INTP is usually very independent, unconventional, and original. They are not likely to place much value on traditional goals such as popularity and security. They usually have complex characters, and may tend to be restless and temperamental. They are strongly ingenious, and have unconventional thought patterns which allows them to analyze ideas in new ways. Consequently, a lot of scientific breakthroughs in the world have been made by the INTP.

The INTP is at his best when he can work on his theories independently. When given an environment which supports his creative genius and possible eccentricity, the INTP can accomplish truly remarkable things. These are the pioneers of new thoughts in our society.