Ancora imparo -- Michelangelo Buonarroti
(I am still learning)

Quotes Top

What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention, and a need to allocate that attention efficiently among the overabundance of information sources that might consume it.
— Herbert Simon

The nation that makes a great distinction between its scholars and its warriors
will have its thinking done by cowards and its fighting done by fools.
— Thucydides

Fantasy, abandoned by reason, produces impossible monsters; united with it, she is the mother of the arts and the origin of marvels.
— Goya

When a task cannot be partitioned because of sequential constraints, the application of more effort has no effect on the schedule. The bearing of a child takes nine months, no matter how many women are assigned.
— Frederick P. Brooks, Jr., *The Mythical Man-Month*

Some ideas are so stupid that only intellectuals could believe them.
— George Orwell

Intelligence is like a four-wheel drive. It allows you to get stuck in more remote places.
— Garrison Keillor

Do one thing every day that scares you.
— Eleanor Roosevelt

My ability to keep cool in a crisis is based entirely on not knowing all the facts.
— Garrison Keillor

The one common experience of all humanity is the challenge of problems.
— R. Buckminster Fuller

The intuitive mind is a sacred gift and the rational mind is a faithful servant.
We have created a society that honors the servant and has forgotten the gift.
— Albert Einstein

The development of general ability for independent thinking and judgment should always be placed foremost, not the acquisition of special knowledge. It a person masters the fundamentals of his subject and has learned to think and work independently, he will surely find his way and besides will better be able to adapt himself to progress and changes than the person whose training principally consists in the acquiring of detailed knowledge.
— Albert Einstein, in *Ideas and Opinions*, p. 62

It is not enough to teach a man a speciality. Through it he may become a kind of useful machine but not a harmoniously developed personality. It is essential that the student acquire an understanding of and a lively feeling for values. He must acquire a vivid sense of the beautiful and of the morally good. Otherwise he – with his specialized knowledge – more closely resembles a well trained dog than a harmoniously developed person. He must learn to understand the motives of human beings, their illusions, and their sufferings in order to acquire a proper relationship to the individual fellow-men and to the community…Overemphasis on the competitive system and premature specialization on the ground of immediate usefulness kill the spirit on which all cultural life depends, specialized knowledge included. It is also vital to a valuable education that independent critical thinking be developed in the young human being, a development that is greatly jeopardized by overburdening him with too much and with too varied subjects. Overburdening necessarily leads to superficiality.
— Albert Einstein, in *Ideas and Opinions*, p. 66-67

Integrity without knowledge is weak and useless, and knowledge without integrity is dangerous and dreadful.
— Samuel Johnson

Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information upon it.
— Samuel Johnson

Iron rusts from disuse,
stagnant water loses its purity and in cold weather becomes frozen;
so does inaction sap the vigors of the mind.
— Leonardo da Vinci

Thinking is the hardest work there is, which is the probable reason why so few engage in it.
— Henry Ford

In the field of observation, chance favors the prepared mind.
— Louis Pasteur

We shall not cease from exploration, and the end of all our exploring will be to arrive where we started and know the place for the first time.
— T. S. Eliot

The other terror that scares us from self-trust is our consistency; a reverence for our past act or word, because the eyes of others have no other data for computing our orbit than our past acts, and we are loath to disappoint them.
...
A foolish consistency is the hobgoblin of little minds, adored by little statesmen and philosophers and divines. With consistency a great soul has simply nothing to do. He may as well concern himself with his shadow on the wall. Speak what you think now in hard words, and to-morrow speak what to-morrow thinks in hard words again, though it contradict every thing you said to-day. — 'Ah, so you shall be sure to be misunderstood.' — Is it so bad, then, to be misunderstood? Pythagoras was misunderstood, and Socrates, and Jesus, and Luther, and Copernicus, and Galileo, and Newton, and every pure and wise spirit that ever took flesh. To be great is to be misunderstood.
— Ralph Waldo Emerson, in his essay “Self-Reliance”

General Research Top

- Muir S. Fairchild Research Information Center
  - Air University Student Research Papers
- Fit to Think: Conceptual, Critical, and Creative Thinking, briefing by Grant Hammond, USAF Center for Strategy and Technology (CSAT)
- How to Do Research, briefing by Grant Hammond, USAF Center for Strategy and Technology (CSAT)

Overall/General Resources Top

- See also fast and slow thinking

- Analogy as the Core of Cognition, by Hofstadter, 2006 Stanford Presidential lecture and a text by Hofstadter from *The Analogical Mind: Perspectives from Cognitive Science*, by Gentner et al, MIT Press, 2001
    - interesting and entertaining pieces on analogy, human cognition, and communicating within a language/culture group -- much of it very applicable to teaching and learning

- How We Think: Thinking Critically and Creatively and How Military Professionals Can Do it Better, by McConnell et al, in *Small Wars Journal*, 16 Sep 2011
    - This essay will summarize how cognitive theorists have described critical and creative thinking in general, and how some military practitioners have applied them. In doing so, this essay will propose principles of critical and creative thinking applicable to the military profession to provide a common vocabulary that describes the type of thinking we do. To expand and improve critical and creative thinking, military professionals need a common vocabulary that accurately describes the very thinking we are to expand and improve on.

- Critical Thinking and Intelligence Analysis (local copy, 1.4 Mb low res), by Moore, National Defense Intelligence College (NDIC) occasional paper no. 14, March 2007 (local copy, 12.1 Mb high res) - includes generic and intel-specific discussion, as well as an appendix which is the NSA's Critical Thinking and Structured Analysis Class Syllabus
    - NSA's Critical Thinking and Structured Analysis Class Syllabus - incudes plans for 10 classes, as well as a template for summarizing articles/readings

- Psychology of Intelligence Analysis (local copy), by Heuer, 1999, for CIA
-- very good examination of many elements of critical thinking, with examples (PDF version)
    - Check out Part III - Cognitive Biases

- Fit to Think: Conceptual, Critical, and Creative Thinking, briefing by Grant Hammond, USAF Center for Strategy and Technology (CSAT)

- How to Do Research, briefing by Grant Hammond, USAF Center for Strategy and Technology (CSAT)

- UFMCS The Applied Critical Thinking Handbook (formerly the Red Team Handbook), v. 8.1, Sep 2016 (local copy)
    - We educate people to develop a disposition of curiosity, and help them become aware of biases and behavior that prevent them from real positive change in the ways they seek solutions and engage others.
- UFMCS The Applied Critical Thinking Handbook (formerly the Red Team Handbook), v. 7.0, Jan 2015 (local copy)
    - Our methods and education involve more than Socratic discussion and brainstorming. We believe that good decision processes are essential to good outcomes. To that end, our curriculum is rich in divergent processes, red teaming tools, and liberating structures, all aimed at decision support.
- UFMCS Red Team Handbook, Apr 2012 (local copy)
    - Each section can almost stand alone, and Section XI – Structured Analytic Techniques – has a large variety of tools/techniques for overcoming “mind-sets” – including “9 Step Cultural Methodology” and “String of Pearls” tool and “Analysis of Competing Hypotheses” and a passel of others.

- Action Learning Guide (local copy), from Presidential Management Fellows (PMF), posted by OPM - check especially the appendices for items/tools such as inference ladder, four frames, conflict management, stakeholder mapping, force field analysis, and more

- Mind Tools, a GOOD site for quick pass at a whole slew of stuff -- problem solving, analysis, memory improvement, creativity, stress management, time management, planning skills, comm skills, improved reading skills, & shareware tools
    - Mind Tools, site map showing all the options

- Peirce, Pragmatism, and The Right Way of Thinking (local copy), by Campbell, Sandia National Labs, Aug 2011
    - Peirce is known as the founder of the philosophy of pragmatism and these lectures, given near the end of his life, represent his mature thoughts on the philosophy. Peirce’s decomposition of thinking into abduction, deduction, and induction is among the important points in the lectures.

- *How We Think*, 1910, by John Dewey

- "Knowing" - self, enemy, situation - the Art of War 2000 (local copy) - a quick, easy read from Navy CIO with topics such as types of cognitive capabilities, and knowing yourself as an agent of change
    - includes the use of storytelling as a transformational tool in the Navy

- Learning Organization Doctrine: Roadmap for Transformation (local copy), US Army Corps of Engineers - definitions, models, outcomes, etc.

- Thinking -- You Can Learn To Do Better What You Think You Already Do Well (local copy), by Hobbs, USMC, research paper for ICAF, 1992

Strategic Thinking Top

Not everything that can be counted counts,
and not everything that counts can be counted.
— Albert Einstein

Nine-tenths of tactics are certain and taught in the books;
but, the irrational tenth is like the kingfisher flashing across the pool.
This is the test of generals.
Success can only be ensured by instinct sharpened by thought.
At the crisis, it is as natural as a reflex.
— T. E. Lawrence, in *The Science of Guerilla Warfare*

The nation that makes a great distinction between its scholars and its warriors
will have its thinking done by cowards and its fighting done by fools.
— Thucydides

- See also critical thinking
- See also decision making
- See also strategic art
- See also military theory page
- See also strategic communication page at the Cyberspace & Information Operations Study Center
- See also DoD and service leadership competency models at Strategic Leadership Studies for competencies to be addressed by military education
- See also the strategic corporal and the three-block war regarding the need for strategic thinking at all levels in today's and tomorrow's conflicts
    - The lines separating the levels of war, and distinguishing combatant from "non-combatant," will blur, and adversaries, confounded by our "conventional" superiority, will resort to asymmetrical means to redress the imbalance. Further complicating the situation will be the ubiquitous media whose presence will mean that all future conflicts will be acted out before an international audience. [Krulak]
- The perils of bad strategy, by Rumelt, in the *McKinsey Quarterly*, (2011, 1)
    - Another sign of bad strategy is fuzzy strategic objectives. One form this problem can take is a scrambled mess of things to accomplish—a dog's dinner of goals. A long list of things to do, often mislabeled as strategies or objectives, is not a strategy. It is just a list of things to do. Such lists usually grow out of planning meetings in which a wide variety of stakeholders suggest things they would like to see accomplished. Rather than focus on a few important items, the group sweeps the whole day's collection into the strategic plan. Then, in recognition that it is a dog's dinner, the label "long term" is added, implying that none of these things need be done today.
    - Bad strategy has many roots, but I'll focus on two here: the inability to choose and template-style planning—filling in the blanks with "vision, mission, values, strategies."
- Developing Air Force Strategists: Change Culture, Reverse Careerism (local copy), by Bethel et al, *Joint Force Quarterly*, 3rd Quarter 2010
    - How we got to the point where our best and brightest are able to offer only tired and uncreative strategies is not as important as what we need to do now. We must develop, nurture, and promote strategic thinkers. We define *strategic thinkers* as those officers who understand the inherent linkages between the abstract and concrete, between thinking and doing, and who eschew old checklists for new ideas and apply those ideas to potential future situations.
    - The Air Force should seek out those officers who have a balanced brain—those who can not only intuit well and rapidly, but who also understand when it may be necessary to look for theories that can be generalized. Instead, the Service teaches "people, processes, and products" that make up the Air Operations Center at its command and staff college.
    - There is no career path for strategists or strategic thinkers, and indeed there appears to be a trend away from intellectualism.
    - Rather than disdaining intellectualism, senior leaders should be encouraged to read recent scholarship on strategic decisionmaking and ask themselves if they can learn something there. In addition to the long list of histories of command and leadership, Air Force senior leaders should have to read Scott Page's *The Difference*, Malcolm Gladwell's *Blink* and *Outliers*, James Surowiecki's *The Wisdom of Crowds*, and most importantly, Alec Fisher's *The Logic of Real Arguments*.
    - The balance between Gladwell and Surowiecki should be lessons that all senior officers learn en route to becoming strategists. Giovanni Gavetti and Jan Rivkin, in *How Strategists Really Think*, tell us that one of the greatest mistakes leaders make is applying the wrong experiential analogies to the situation at hand. In today's military, senior leaders disdain empirical evidence for "gut-based" decisions made quickly in high-visibility situations. As Watts mentions, too many of our leaders go on experience and apply lessons from the past to the problem at hand. The current problem, however, is rarely like any they previously faced; thus, the lessons they bring forward are not relevant. Experience is important, but for senior leadership we should seek out those who can adapt to the situation no matter what it is. Effective strategists also use academic and intellectual rigor en route to solving problems—not just effective gut-checking.
    - We mentioned earlier the trend toward relying on experience rather than critical thinking and inductive reasoning. Inductive reasoning is not hard merely for military officers, but for almost everyone. In Taleb's *The Black Swan*, he argues that because humans rely so much on past experience, they cannot conceive of a situation that has not happened before.
    - Inductive reasoning is only one attribute of successful strategists. They must also exhibit:
        - creativity
        - curiosity
        - confidence
        - high intelligence without subject fixation
        - ability to collate and make sense out of massive amounts of data
        - great and diverse intellect
        - thorough knowledge of the means
        - intuitive understanding of the ends.
    - We place creativity at the top because crafting strategies, like war itself, is an art. We posit that educating an officer to be a strategist is for naught if the first four traits are not present.
    - We must demand more of our officers—not in terms of time or energy (most give more than their fair share whether they have it or not), but in terms of how they *think*.
    - Let us be clear on one point: deductive thinking is required in campaign planning and in airpower theory, especially when it comes to establishing quantifiable metrics and measuring against them. Pressed up against the realities of war, deductive thinkers do a great job killing the enemy, but it is inductive thinkers who

master how to discourage enemy forces from wanting to continue to fight. And it is inductive thinkers who are best able to determine how to achieve victory on a variety of battlefields against innumerable conflicts and challenges. The metrics to measure each are very different. One is an empirical count while the other cannot be measured.

- Growing Strategic Leaders for Future Conflict, by Salmoni et al, *Parameters*, Spring 2010

- Schools for Strategy: Teaching Strategy for 21st Century Conflict (local copy), by Gray, SSI, Nov 2009

- Research, Writing, and the Mind of the Strategist (local copy), by Foster, in *Joint Force Quarterly*, Spring 1996
  - Ideas and the ability to generate them seem increasingly likely, in fact, to be more important than weapons, economic potential, diplomatic acumen, or technological advantage in determining who exercises global leadership and enjoys superpower status. Thus it is imperative to develop, nurture, and engage strategic thinkers at all levels—critical, creative, broadgauged visionaries with the intellect to dissect the status quo, grasp the big picture, discern important relationships among events, generate imaginative possibilities for action, and operate easily in the conceptual realm.
  - Almost by definition, strategic thinkers are broadly educated, not narrowly trained. They seek not simply direction but to grapple with the underlying questions of whether, why, and what if.
  - A broad-based education expands—and fuels the self-guided growth of—one's horizons. It develops the intellect and inculcates the spirit of inquiry for a lifelong pursuit of learning. The measure of education, far from being the level or even the sum of formal schooling, rests more in the degree of open-mindedness and active mental engagement it engenders.

- Keeping the Strategic Flame (local copy), by Builder, in *Joint Force Quarterly*, Winter 1996-97
  - The current demand by the military for welldefined objectives is eloquent evidence of how far our thinking has drifted toward the tactical domain. The insistence on operationally planning based on enemy capabilities, while tactically prudent, is the antithesis of strategic thinking, which should concentrate on enemy vulnerabilities. Although defeating enemy forces may sometimes be necessary to achieve our objectives, it is not always the Nation's or the military's best option.

- Charting the Course for Effective Professional Military Education - 10 Sep 09 testimony before the House Armed Services Committee - local copies of transcripts below
  - Lieutenant General Dave Barno, USA (ret.) - Director, Near East South Asia Center for Strategic Studies
    - Given the notable shortcomings many ascribe to U.S. strategic thinking over the last decade -- some deeply involving senior military leaders -- we must seriously question whether our program of PME today is on the right track. In my estimation, we are drifting off course, and if uncorrected, our marked advantage in the intellectual capital of warfare, in the face of an increasingly uncertain future, is at risk.
    - Thus, for almost all senior officers -- all our generals and admirals -- the final fifteen to twenty years of their career is almost entirely largely lacking in extended developmental experiences. This fact becomes more troubling when correlated with the reality that decision-making and complexity at the senior levels -- especially regarding strategic and grand strategic issues -- is immensely more complex and uncertain than the relatively simpler worlds of tactics and operations. So-called "wicked problems" unresponsive to set-piece solutions abound.
  - Dr. Williamson Murray - Senior Fellow, Institute for Defense Analyses
    - The cost of the wars in Iraq and Afghanistan suggests that the United States can no longer afford an approach resting on the comfortable assumption that commanders can acquire skills on the fly to deal with the new and different complexities that each conflict will bring in its wake. As General James Mattis suggested in an email to a professor at National War College, "We have been fighting on this planet for 5,000 years and we should take advantage of that experience. 'Winging it' and filling body bags as we sort out what works reminds us of the moral dictates and the cost of competence in our profession." The depressing story of our flawed efforts to handle a burgeoning insurgency during the post-invasion period in Iraq suggests that too many senior officers had never studied the lessons of Vietnam, much less the experiences of the British in their efforts to defeat the 1920 insurgency in Iraq.
  - Dr. John Allen Williams - President, Inter-University Seminar on the Armed Forces and Society
    - Given the complexity of the future threat environment and the importance of the issues involved – military threats and the proper relation between the military and the society it serves –the Skelton Report's call for the development of strategists and the encouragement of strategic thinking is increasingly relevant. One should note that these are not quite the same thing. Only a small number of officers will develop into strategists of the first rank, but these are so important that the PME system must do as much as it can to encourage them to develop their talents to the maximum degree possible.

- Developing Strategic Leaders for the 21st Century (local copy), by McCausland, SSI, Feb 2008

- Strategy and the Strategic Way of Thinking (local copy), commentary by Owens, Naval War College Review, Autumn 2007

- Educating for Strategic Thinking in the SOF Community: Considerations and a Proposal (local copy), by Yarger, JSOU Report 07-2, Jan 2007

- Prospects for Strategic Thinking and Innovation: a Survey of War College Students (local copy), by Snow, Army War College, 15 Mar 2006
  - The survey reveals room for improvement in current levels of dialogue, critical, innovative and strategic thinking. Unless changed, the current time and resource constraints will likely frustrate deep thinkers, stifle the creative and hinder the process of organizational learning and adaptation. The goal of achieving advantage through transformational processes is at risk.

- Learning from the Stones: a *Go* Approach to Mastering China's Strategic Concept, *Shi* (local copy), by Lai, Strategic Studies Institute, May 2004
  - The author introduces a new approach to learning about the different ways of strategic thinking and interaction in Chinese culture. It is through learning the Chinese board game called *go*. This game is a living

reflection of Chinese philosophy, culture, strategic thinking, warfare, military tactics, and diplomatic bargaining. The author also sheds light on the remarkable connection between go and the strategic concepts in Sun Tzu's *Art of War*.
    - A modest claim is made in this writing that a little knowledge of *go* will take U.S. leaders a long way in understanding the essence of the Chinese way of war and diplomacy.

- Strategic Thinking chapter from *Strategic Leadership and Decision Making*, from National Defense University
    - A leader can develop more effective strategic thinking skills. This is done by exploiting any opportunity to better understand yourself, how you think about complex problems, and how to go about making decisions. This understanding of yourself is critical, since this information that forms the foundation for developing your strategic thinking capabilities necessary in the strategic environment. The more you understand yourself, the more control you have over both the process, and the products you produce.
    - Virtually all of you will be required to serve in strategic environments. This means there will be many opportunities for you to function as a strategic thinker or advisor. You must, therefore, continue to develop a new and broader set of thinking skills. The SLDM course, and the overall ICAF experience have been designed to help you understand and develop effective strategic thinking skills to solve the complex, fast changing, unstructured problems you will soon encounter.

- Attack by Stratagem, from *The Art of War*, by Sun Tzu
    - Hence to fight and conquer in all your battles is not supreme excellence; supreme excellence consists in breaking the enemy's resistance without fighting.
    - Hence the saying: If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle.

Disruptive Thinking Top

- Disruptive Thinking and how the iPad changed Close Air Support in Afghanistan, by Christman, for *Small Wars Journal*, 15 May 2012
    - uses an example of an Army captain giving his Cobra helicopter a moving GPS map function, using an iPad
    - "I would argue the Marine Corps is going to need more of these types of Marines as we enter the next 10-15 years of fiscal austerity. As is often quoted, "we're out of money, its time to think". We as Marines, especially the Staff NCOs and company grade officers, need to do better at taking responsibility for our own organization. The following are some ideas of how Disruptive Thinkers can be more effective. [ed. - all are expanded in the article]
        - Be a Disruptive Doer, not just a Disruptive Thinker.
        - Be ready for a bureaucratic knife fight.
        - Don't forget that the Marine Corps is a warfighting institution, not a think tank.
        - Sometimes you can do more good outside of the military.
    - "With that being said, some responsibility does lie on leadership. We do a very poor job at leveraging our best minds and our most talented leaders. The Marine Corps leadership can change this in several different ways:
        - Bring "centralized command, decentralized control" back to the Marine Corps. Innovation is often a bottom up process, where those closest to the fight have the best solutions. Giving subordinate commanders flexibility to make these decisions will allow the most creative junior leaders to develop innovative solutions to existing problems.
        - Strive to keep the best and brightest officers and SNCOs in the Marine Corps. ... If you want effective Colonels and Generals you need to keep effective Lieutenants and Captains.

- The Military Needs More Disruptive Thinkers, by Kohlmann, for *Small Wars Journal*, 5 Apr 2012

- Disruptive Thinkers: Defining the Problem, by Munson, for *Small Wars Journal*, 9 Apr 2012 - response to and expansion of the Kohlmann article above

- Disruptive Thinkers (and the military) posts at *Small Wars Journal*

- Identifying Disruptive Technologies Facing the United States in the Next 20 Years (local copy), by Mitchell, CGSC thesis, 2009

Crowdsourcing and Outliers Top

- see also *The Wisdom of Crowds*, by James Surowiecki

- Matt Ridley: When ideas have sex - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
    - "At TEDGlobal 2010, author Matt Ridley shows how, throughout history, the engine of human progress has been the meeting and mating of ideas to make new ideas. It's not important how clever individuals are, he says; what really matters is how smart the collective brain is.
    - Matt Ridley argues that, through history, the engine of human progress and prosperity has been, and is, "ideas having sex with each other."

- Riley Crane: Crowdsource win - 17 minute video - a Pop Tech Talk
    - Riley Crane, a postdoctoral fellow at the MIT Media Lab, found out about the DARPA Red Balloon Challenge four days before it started (find ten balloons placed in ten different locations around the country). Four days, eight hours, and 52 minutes later his team had won the competition. Watch him talk about how they did it and the challenges they encountered in the process.
    - He also talks about other uses of the techniques - including rescues in Haiti - and about how our communication paradigms are broken and how they need to change.

- Intelligence agencies turn to crowdsourcing, by Weinberger, for BBC CODE RED, 10 Oct 2012

- Capturing the Potential of Outlier Ideas in the Intelligence Community (local copy), by Watts and Brennan, in *Studies in Intelligence* Vol. 55, No. 4, Dec 2011

    - What are outliers in the context of the intelligence profession? Outliers are data and hypotheses that analysts may too quickly dismiss. They may be the imaginative, even prescient analyses policymakers cannot bring themselves to believe. Intelligence analysts generally possess healthy doses of skepticism to help them avoid the pitfalls of hubris and self-delusion, but, sadly, this is insufficient, for the outliers that ultimately prove to be the seeds of surprise are outlandish, unthinkable, and wholly anomalous.

- Building a Wise Crowd (local copy), based on James Surowiecki's bestseller *The Wisdom of Crowds*, from "Ask the Academy" at NASA Academy, 24 Feb 2006 - showing how a group of people's diverse answers to a question, when put together, can be better than the expert's - in some cases, not all
    - Surowiecki identifies four characteristics of wise crowds:
        - The crowd must be diverse, which allows the individual members to bring different pieces of relevant information to the table.
        - It needs to be decentralized so that no individual member is dictating what the answer should be.
        - It needs a mechanism for distilling the group's opinion into a collective verdict.
        - The individual crowd members have to be independent, so they remain true to their own information and perspective while not worrying about what the other members of the group think of them.
    - Surowiecki explains: "The paradox of the wisdom of crowds is that the best group decisions come from lots of independent individual decisions."

- How to pioneer a successful crowd-sourcing site (local copy), by McKeel, National Renewable Energy Laboratory (NREL), 1 Nov 2011

- Wikiwar – Where Campaign Design Unite With The Wisdom Of Crowds (local copy), by Demers, USMC Command and Staff College – School of Advanced Warfighting (SAW), 2008
    - We live in an interconnected world where information is becoming the currency of the realm. According to UC Berkeley School of Information we produce more than 550,000 Terabytes of data each year and our current adversaries are leveraging this wealth of information into concrete operational advantages better then we can. By shying away from traditional operational security principles and moving to what could be described as open source warfare, they can adapt more quickly to a given situation. A striking example of open source can be found in the Iraqi insurgency. It took only 12 months to reach (and surpass) capabilities for the deployment of the full spectrum of IEDs in Iraq that took over 30 years for the IRA to achieve under more rigorous operational security (OPSEC) conditions in Ulster.
    - This paper will propose that a concept of open source warfare will be far more effective in supporting a campaign design methodology during complex emergencies as opposed to the traditional compartmentalized approach favoured in today's military planning process. First of all, we will look where this concept can be employed and why it would work. Having identified where open source can be useful for the military, we will turn our attention to the need of changing our understanding of OPSEC. Finally, we will propose an open source planning model which will allow us to better leverage information during campaign design and execution.

- Universal Access to and Use of Information (local copy), from FEMA-sponsored *Strategic Foresight Initiative*, May 2011
    - In the last decade, technological advances in both computer hardware and software have greatly enhanced people?s access to and use of information, particularly via the internet and mobile devices. Based on this capability and access, the following trends and drivers have the potential to impact emergency management activities:
        - Internet access expansion
        - People as both producers and consumers of information
        - Spontaneous reporting
        - Crowdsourcing
        - Increased emergency management use of the internet and social media

- Hunting for Foxes: Capturing the Potential of Outlier Ideas in the Intelligence Community (local copy), by Watts and Brennan, in CIA's *Studies in Intelligence*, Dec 2011
    - Outliers are data and hypotheses that analysts may too quickly dismiss. They may be the imaginative, even prescient analyses policymakers cannot bring themselves to believe. Intelligence analysts generally possess healthy doses of skepticism to help them avoid the pitfalls of hubris and self-delusion, but, sadly, this is insufficient, for the outliers that ultimately prove to be the seeds of surprise are outlandish, unthinkable, and wholly anomalous.
    - Our interest in outliers was born out of Internet-based surveying that Clint Watts undertook on 2 January 2011. The purpose of that survey was to test the ability of crowds to make accurate hypotheses about future counterterrorism issues in the event of Usama Bin Laden's death.

- Would you like to play a game? Solving real problems using game mechanics. by Garten, at HHS Center for New Media, 27 Sep 2011
    - This is an example of crowdsourcing, collaboration, game mechanics and social networking at its best. Instead of doing each of these activities in isolation, these elements were brought together as a powerful tool to solve a real world problem. "The researchers noted that much attention has been given to the possibilities of crowd-sourcing and game playing in scientific discovery. Their results indicate the potential for integrating online video games into real-world science."
    - In cases where we have the basics of social/new media covered, let's keep advancing and level up to thinking about game mechanics as another tool in our problem solving toolbox. Not only can we apply the idea of gaming to our citizen engagement strategies on the communications level, but perhaps we can pave the way in helping others see the value in applying game mechanics to their own areas of responsibility.

- Blaise Aguera y Arcas demos Photosynth, a talk from TED.com (but you may need to watch it on YouTube if the TED.com version won't run on your computer)
    - "Blaise Aguera y Arcas leads a dazzling demo of Photosynth, software that could transform the way we look at digital images. Using still photos culled from the Web, Photosynth builds breathtaking dreamscapes and lets us navigate them."

- Wikipedia list of crowdsourcing projects

Collaboration Top

- .Collaboration - Affect/Possibility: Ken Blanchard at TEDxSanDiego 2012, Published on Dec 27, 2012
  - Stating that "no one of us is as smart as all of us," Ken Blanchard teaches us three aspects of successful collaboration:
    1. if you meet someone who wants to accomplish something, and you want to accomplish something, the experience is meant to be dynamic;
    2. rely on the different skills and experience people bring to the table;
    3. "essence" and "form" are the two characteristics of a solid collaboration.

- Clay Shirky on institutions vs. collaboration - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "In this prescient 2005 talk, Clay Shirky shows how closed groups and companies will give way to looser networks where small contributors have big roles and fluid cooperation replaces rigid planning."

- Howard Rheingold on collaboration - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "Howard Rheingold talks about the coming world of collaboration, participatory media and collective action -- and how Wikipedia is really an outgrowth of our natural human instinct to work as a group."

- Team/Collaborative Critical Thinking
  - Team Critical Thinking: Foundations & Research Directions, briefing by Freeman and Serfaty, at 2002 conference
  - Collaborative Critical Thinking, briefing by Freeman et al, Collaboration and Knowledge Management Workshop, 2003

- Collaboration and Self Assessment: How to Combine 360 Assessments to Increase Self-Understanding (local copy), by Psotka et al, ARI Report, Mar 2007

- Why Wikis at NASA? (local copy), by Verville et al, in NASA's *ASK* magazine, issue 44, Fall 2011
  - Wikis are used across NASA for collaboration
  - Some of the critical practices and principles for successful wikis are listed below.
    - Wikis work best when they solve a problem that is evident to most of a group.
    - Wiki use needs to replace an existing work process, not add to work.
    - Wikis need advocates and advertising.
    - Seeding the wiki with valuable content helps jump-start the process; with a blank page, no one knows where to start.
    - Gradual growth is fine, and starting small helps a core group of users become accustomed to the wiki (think pilot study).
    - A wiki that serves a niche need is okay; it does not need to be all things to all people.

Developing Adaptiveness Top

- Achieving Adaptability through Inquiry Based Learning (local copy), by Duffy and Raymer, ARI report, Apr 2010
  - This report presents inquiry based learning (IBL) as an instructional strategy addressing the Army's need for training flexible and adaptive leaders. Distinguishing tenets of IBL are characterized in contrast to the Army's current direct instruction strategy. Elements of IBL, including characterization of the orienting problem, learner support by the instructor, and assessment of learner outcomes are outlined. Considerations for developing an IBL curriculum are addressed, and details of an example of an Army IBL course of instruction are provided.

- Adaptive Thinking Training For Tactical Leaders (local copy), by Lussier and Shadrick, ARI paper presented at the RTO HFM Symposium, Oct 2003
  - This paper reports a series of research efforts embodied in the U.S. Army's Think Like a Commander training program. The work is interesting because it seeks to train a cognitive behavior – thinking – using methods that have traditionally been applied to training more observable and measurable behaviors, e.g., marksmanship and gunnery, sports performance. In short, it does not greatly respect a traditional distinction between such things as physical movements, perceptions, and cognitions when it comes to training, rather treats these all as behaviors that are amenable to the same training methods and principles. Deliberate practice techniques were applied to develop exercises to train the task of adaptive thinking in tactical situations.

- Developing Leaders to Adapt and Dominate for the Army of Today and Tomorrow (local copy), by Davis and Martin, *Military Review*, Sep-Oct 2012
  - Change in the College comes in how we accomplish our educational mission, as well as within the content of our courses. This change is an active, evolutionary educational process that drives the institution to reexamine itself on a frequent basis. The operational environment is dramatically different than in previous times. Additionally, there has been a tremendous growth in understanding of adult learning and professional education, and CGSC is leveraging this new science. We are educating a different generation of emerging leaders who bring incredible experience to the classroom to share. Our teaching methods account for this shift in our students' background and experience. The most obvious difference over the previous 30 years is that more than 90 percent of our Army students have recent combat experience and nearly 70 percent have multiple combat tours. Based on this background, and the ever-changing operating environment that is our world, it is easy to see that change remains a constant in the process of leader development and education for the Army.

Creativity and Innovation Top

> Logic will get you from A to B.
> Imagination will take you everywhere.
> — Albert Einstein

Reasonable people adapt themselves to the world.
Unreasonable people attempt to adapt the world to themselves.
All progress, therefore, depends on unreasonable people.
— George Bernhard Shaw

If the world were perfect, it wouldn't be.
— Yogi Berra

A good hockey player plays where the puck is.
A great hockey player plays where the puck is going to be.
— Wayne Gretzky

Creativity is thinking up new things. Innovation is doing new things.
— Theodore Levitt

The only thing harder than getting a new idea into the military is getting an old one out.
— Liddell Hart

Anxiety is the hand maiden of creativity.
— T. S. Eliot

The foolish and the dead alone never change their opinions.
— James Russel Lowell

As the births of living creatures, at first, are ill-shapen: so are all Innovations, which are the births of time.
— Francis Bacon

He that will not apply new remedies must expect new evils; for time is the greatest innovator.
— Francis Bacon

In times of change, learners inherit the earth, while the learned find themselves equipped to deal with a world that no longer exists.
— Eric Hoffer

The world owes all of its onward impulses to men ill at ease. The happy man inevitably confines himself within ancient limits.
— Nathaniel Hawthorne

I want to stay as close to the edge as I can without going over. Out on the edge you see all kinds of things you can't see from the center.
— Kurt Vonnegut, Jr.

In the age of information sciences, the most valuable asset is knowledge, which is a creation of human imagination and creativity. We were among the last to comprehend this truth and we will be paying for this oversight for many years to come.
— Mikhail Gorbachev, 1990

Innovation by definition will not be accepted at first. It takes repeated attempts, endless demonstrations, monotonous rehearsals before innovation can be accepted and internalized by an organization. This requires 'courageous patience'.
— Warren Bennis

- See John Boyd and the OODA loop - especially the articles and briefings by Osinga
- See also intuition
- See also Creative Problem-Solving (CPS) process
- See also Innovation Adoption-Diffusion on Transformation of War page
- See also Innovation Adoption-Diffusion on CSAT Future Studies page
- Global Innovation Index (GII) - with ranking of countries
- Joint Chiefs Chairman Urges Military Innovation
- Eric Berlow and Sean Gourley: Mapping ideas worth spreading - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
    - "What do 24,000 ideas look like? Ecologist Eric Berlow and physicist Sean Gourley apply algorithms to the entire archive of TEDx Talks, taking us on a stimulating visual tour to show how ideas connect globally."
- "Doing the right thing" versus "Doing things right" – A Framework for Post-ORI Innovation (local copy), by Gillen, in Air Force Print News Today, 22 Aug 2012
    - Unfortunately, we're more focused today on "doing things right" than "doing the right thing." This has become apparent as we prepare for the upcoming inspection. "Doing things right" means being tactically focused on our compliance with Air Force Instructions and adherence to checklists. "Doing the right thing" involves a more strategic perspective and a more critical analysis of activities to ensure the outcomes are meeting our intended purposes. Through a process of strategic innovation we can transition from "doing things right" to "doing the right thing," a shift which will ultimately result in organizational efficiencies and increased job satisfaction.
- Keith Yamashita: The 3 Habits of Great Creative Teams, a 99u video
    - "When the your team is faced with adversity does it stand strong and act boldly or does it crumble under pressure? Based on his work with over 1000 teams, Keith Yamashita shares his insights about great

collaborative environments including: have an awareness beyond your day-to-day, respect the unique talents of your team members, and actively cultivate meaningful one-on-one relationships."

- Creative Thinking for Senior Leaders: An essay on creative thinking for military professionals (local copy), by Allen, U.S. Army War College, May 2012
- Creative Thinking for Individuals and Teams: An essay on creative thinking for military professionals, by Allen, U.S. Army War College, 2009
  - quick overview (13 pages) of theories, theorists, processes, attributes, and more
- Developing Creative and Critical Thinkers (local copy), by Allen and Gerras, in *Military Review*, Nov-Dec 2009

- "Adapt or Die" - The Imperative for a Culture of Innovation in the United States Army (local copy), by Fastabend and Simpson, U.S. Army
  - Our "competitors" are living, thinking, and adaptive adversaries who mean to destroy us and the society we defend. Our choice is quite clear: "Adapt or Die." Failure does not mean Chapter 11 and an updated resume. Failure means death and destruction for ourselves, our comrades, and all that we cherish.

- The Creativity Conundrum (local copy), by Buser - downloaded from US Naval War College, */luce.nt/*, "A Journal of National Security Studies," 2012
  - The ability to be creative, or think creatively, has long been recognized as a core component to successful leadership at all levels of command. Especially at the strategic level, the ability to think creatively and adapt to changing circumstances is often the difference between life and death, victory and defeat. ... And despite general agreement to this fact by most senior leaders, the military on the whole is ill-equipped for producing leaders who are adaptable, flexible, and who can think creatively. Rather, its personnel makeup, focus on operations, and sheer bureaucracy all combine to create and reward leaders who are risk-averse, conformists, and good at maintaining the status quo.

- How Switching Tasks Maximizes Creative Thinking, by Jarrett, at 99U

- Top 10 Ways to Create Innovation in the Workplace (local copy), downloaded from the 3rd Marine Logistics Group

- Center of Innovation (CoI), US Air Force Academy
  - "The Department of Homeland Security Science and Technology Directorate funded Center of Innovation (CoI) at the United States Air Force Academy (USAFA) was established in 2008 and has become a leader in championing game-changing innovations for the US Government (USG) by leveraging unique public-private partnerships."
  - "The CoI has become the 'sandbox' for government agencies, private industry giants, and academia to perform collaborative research, share expertise, and shape technologies within the private sector to fit government needs"
  - DHS pamphlet talking about the CoI (local copy)

- NASA Center of Excellence for Collaborative Innovation
  - "Established in 2011, the CoECI serves to advance the use of open innovation methods across the federal government, in particular, the use of prizes and challenge. The CoECI provides guidance to other federal agencies and NASA centers on implementing open innovation initiatives from problem definition, to incentive design, to post- submission evaluation of solutions."

- Office of Innovation - Office of Naval Research

- Navy Warfare Development Command (NWDC)
  - Navy Center for Innovation (NCFI)
  - Shaping Navy Culture: A Campaign Plan for 2025 (local copy), by Tyler, NWDC White Paper, 14 Feb 2012
    - This white paper introduces a concept to change Navy organizational culture into an innovative, intellectually agile institution. This paper examines current conditions, introduces an approach, identifies themes, and proposes actions to build momentum for the concept.

  - Innovator's Guide (local copy, 3.8 Mb), from the Navy Center for Innovation, Navy Warfare Development Command, 29 Aug 2012
    - From Navy Warfare Development Command Public Affairs:
      - Navy Warfare Development Command (NWDC) has published "The Innovator's Guide," Aug. 29, to help innovators of all ages - but particularly the Navy's junior leaders - become more innovative and facilitate the transformation of good ideas into real warfighting capabilities.
      - As the Navy Center for Innovation, NWDC is spearheading a campaign to reinvigorate a culture of innovation within the Navy, and the guide is an important component of that endeavor.
      - In addition to defining innovation and why it is important, the guide provides advice on how to identify and define problems that need solving, proven techniques for finding creative solutions, and how to move these ideas through a large organization to drive towards implementation.
      - "Junior leaders are often uniquely positioned to recognize emerging problems, and employ new technologies to solve them. It's up to us to give them the tools and the open channels to be successful," said Rear Adm. Terry B. Kraft, commander, NWDC.
      - In his introduction, Kraft challenges the junior leaders to think deeply, question continuously, debate vigorously, read broadly, write boldly and never give up on a good idea.
      - To download The Innovator's Guide, visit https://www.nwdc.navy.mil/default.aspx. Videos and transcripts from NWDC's Maritime Innovation Symposium and Junior Leader Innovation Symposium are also available at the website.
    - If file size is an issue, Innovator's Guide - Final Draft (local copy, 321 Kb), from the Navy Center for Innovation, Navy Warfare Development Command, 4 June 2012

  - Maritime Innovation Symposium, 13-14 Mar 2012
    - Maritime Innovation Symposium, After Action Report (local copy), 30 Mar 2012

    - Junior Leader Innovation Symposium (JLIS), 6 Jun 2012
        - JLIS Readahead - Ideas and Initiative: The Junior Leaders Role in Innovation (local copy)
        - Junior Leader Innovation Symposium, After Action Report (local copy), 27 Jun 2012
    - Pacific Rim Innovation Symposium, 10-11 Oct 2012
        - Agenda and Presentation Slides
        - held in San Diego and over Defense Connect Online on 10-11 October 2012, for E-5 to O-5 junior leaders
        - attendees were asked to work on three challenges facing warfighters in the Pacific Fleet
        - NWDC Navy Center for Innovation (local copy), briefing slides of CAPT Tyler, 11 Oct 2012
        - Pacific Rim Innovation Symposium, After Action Report - DRAFT (local copy), 1 Nov 2012

- Will It Work Here? A Decisionmaker's Guide to Adopting Innovations (local copy), Agency for Healthcare Research and Quality (AHRQ), Sep 2008
    - medical focus, but contains many questions every organization should ask about adoption of potential innovations

- Military Innovation in the Rise and Fall of Great Powers: Lessons for America (local copy), by Taylor, NPS thesis, June 2011
    - A military's ability to adapt its organization, doctrine, and technology strategy to meet the threats of its time influences the state's capacity to maintain great power status. This thesis uses a historical overview of military innovation among great powers throughout history to draw lessons for the U.S. military today.
    - ... Finally, and most importantly, this study finds it essential to foster a climate and institutional culture receptive to innovation.
    - A true meritocracy would allow leaders to promote the most promising soldiers and officers despite their inability to meet any time-in-service requirements. The "year-group" promotion system codifies a rigid bureaucratic structure that ensures slow change and little innovation.

- How PowerPoint Stifles Understanding, Creativity, and Innovation Within Your Organization, by Zweibelson, in *Small Wars Journal*, 4 Sep 2012 - includes eight recommendations at the end, to "restore the briefer as a critical thinker"
    - PowerPoint provides a useful vehicle for sharing and developing concepts among military professionals in a variety of venues. Unfortunately, the U.S. military tends to lose track of the supportive context for PowerPoint and instead shackles organizations to institutional processes and rigid 'group-think.' We tend to burden our military professionals with an exhausting and high-maintenance requirement to churn out repetitive and non-explanatory slide decks for nearly every conceivable information requirement. Rarely do we conduct a meeting without the ever-present bright projection of PowerPoint upon a screen.
    - When you attend a briefing and the majority of slides and material attempt to reduce, measure, categorize, or describe something, we are often merely admiring the problem.
    - Instead of thinking about why something is occurring, we are usually required to answer precise information that satisfies a descriptive (WHAT-centric) procedure instead of a critical line of inquiry. Many military professionals refer to this as "feeding the beast" in PowerPoint-centric organizations, where we openly acknowledge that our own hierarchy often demands volumes of often meaningless or irrelevant information for illusionary pretexts. If descriptive thinking blinds your organization to critical and creative thinking, then PowerPoint is the drug of choice for continuing the reductionist and highly tacticized mentality across an organization that fears uncertainty.
    - Additionally, a recent trend of cramming four slides onto one "quad chart" slide is another work-around that compresses a larger slide show into fewer yet more cluttered slides and supports the 'quantity over quality' tension. This recent staff technique defeats the purpose of a quadrant chart that uses two separate tensions in an overlapping geometric structure to demonstrate patterns and explore complex relationships. 'Quad charts' are not interrelated if you apply one simple test. By removing one quadrant of a true 'quad chart', you will render the entire slide incomplete. Each quadrant in a quad chart should systemically relate to the other quadrants in terms of context. If you are only removing one component while the three remaining quadrants maintain their coherence, your staff has merely shoved ten pounds of dirt into a five pound bag for you, by condensing four slides into one. This reduces total slide numbers, but does little to improve organizational learning.
    - Many military organizations use 'read-ahead' packets that provide an advanced copy of the PowerPoint briefing slides in advance of the briefing. In theory, this implies an alternate route for information sharing that, when combined with a briefing, could function in tandem. In practice, this requires two commitments that are rarely met. First, all attendees must endeavor to actually read the 'read-ahead' packet. This prepares an audience to enter a briefing cognizant of the topics, context, and prepared to offer relevant discourse to drive emergent thought. Secondly, the briefer must resist using any slides in the 'read-ahead' except for ancillary or expository reasons during the brief. Simply following the exact slide format as the 'read-ahead' drags those that invested time to read it earlier back through redundant information, and reward those that came to the meeting unprepared.

- Innovating the Future: From Ideas to Adoption, by Denning, in *The Futurist*, Jan-Feb 2012 - "Futurists and innovators can teach each other lessons to help their ideas succeed." - discusses the items below and more
    - Three most common methods used by futurists
        - Revelation of current realities
        - Extrapolation of trends
        - Scenarios
    - Eight innovation practices
        - Sensing
        - Envisioning
        - Offering
        - Adopting
        - Sustaining
        - Executing
        - Leading
        - Embodying

- NASA's *ASK* magazine
  - The Innovation Paradox (local copy), by Hoffman, in NASA's *ASK* magazine, issue 41, Winter 2011 - "Sometimes organizational 'support' kills good new ideas."
    - Many organizations live and die by good new ideas. The challenge they face is to cultivate good ideas by giving innovators just the right blend of freedom and support. One simple approach that is not taken often enough is to let the innovators themselves decide how the organization can help them develop their ideas. A manager asking, “What do you need from me?” has a good chance of finding the sweet spot between no support (“Do what you want as long as I don’t know about it”) and idea-killing interference.
  - Expecting the Unexpected (local copy), by Frasqueri-Molina, in NASA's *ASK* magazine, issue 43, Summer 2011 - creating a mitigation plan to deal with unexpected risks
    - The author developed a risk-mitigation plan to reestablish order from chaos.
      1. Remain calm.
      2. Halt the entire project or just the affected work momentarily and let everyone take a break.
      3. Immediately gather the resolution team, which consists of the project manager and any of the people who can offer solutions; meet privately.
      4. Assess risk impact.
      5. Brainstorm solutions.
      6. Choose a solution.
      7. Obtain project sponsor approval.
      8. Communicate the solution to the entire team, resume project, resolve risk.
  - Why Wikis at NASA? (local copy), by Verville et al, in NASA's *ASK* magazine, issue 44, Fall 2011
    - Wikis are used across NASA for collaboration
    - Some of the critical practices and principles for successful wikis are listed below.
      - Wikis work best when they solve a problem that is evident to most of a group.
      - Wiki use needs to replace an existing work process, not add to work.
      - Wikis need advocates and advertising.
      - Seeding the wiki with valuable content helps jump-start the process; with a blank page, no one knows where to start.
      - Gradual growth is fine, and starting small helps a core group of users become accustomed to the wiki (think pilot study).
      - A wiki that serves a niche need is okay; it does not need to be all things to all people.

- Defense Science Board (DSB) - check reports section for reports like the following
  - Enhancing Adaptibility of Our Military Forces
    - Enhancing Adaptability of our Military Forces (Part A, Main Report) (local copy), released Jan 2011
    - Enhancing Adaptability of our Military Forces (Part B, Appendices) (local copy), released Jan 2011

- Innovation Versus Adaptability: Seizing the Initiative Through Creative Thinking Versus Reacting to the Enemy (local copy), by Grothe, SAMS paper, 2009
  - Leadership must be committed to learning, underwrite experimentation, and create an environment that generates creative thought and innovation. Doctrine must incorporate more aspects of innovation, creative and critical thinking and innovative leadership. The Army’s training constructs produce adaptive leaders, but must start to assess innovation as well, in order to generate this within the force as well. The most critical area the Army must focus change in is within Professional Military Education for field grade officers.

- Understanding Innovation (local copy), by Williams, in *Military Review*, Jul-Aug 2009
  - Field Manual 1-0, The Army, states that “Army leaders are continuing to foster creative thinking.” They are “challenging inflexible ways of thinking, removing impediments to institutional innovation, and underwriting the risks associated with bold change.”
  - Perhaps this statement is true, but given the contemporary use of the word “innovation,” it is also meaningless. Claiming to be innovative carries about as much weight as declaring a love for puppies; it’s easy to say and unpopular to challenge. When words represent some indistinct idea, they are susceptible to reinvention or distortion with potentially significant unintended consequences.

- Innovation Starvation, by Stephenson, in *World Policy Journal*, Fall 2011
  - Still, I worry that our inability to match the achievements of the 1960s space program might be symptomatic of a general failure of our society to get big things done.
  - Innovation can’t happen without accepting the risk that it might fail. The vast and radical innovations of the mid-20th century took place in a world that, in retrospect, looks insanely dangerous and unstable.
  - Today’s belief in ineluctable certainty is the true innovation-killer of our age. In this environment, the best an audacious manager can do is to develop small improvements to existing systems—climbing the hill, as it were, toward a local maximum, trimming fat, eking out the occasional tiny innovation—like city planners painting bicycle lanes on the streets as a gesture toward solving our energy problems. Any strategy that involves crossing a valley—accepting short-term losses to reach a higher hill in the distance—will soon be brought to a halt by the demands of a system that celebrates short-term gains and tolerates stagnation, but condemns anything else as failure. In short, a world where big stuff can never get done.

- How We Think: Thinking Critically and Creatively and How Military Professionals Can Do it Better, by McConnell et al, in *Small Wars Journal*, 16 Sep 2011
  - This essay will summarize how cognitive theorists have described critical and creative thinking in general, and how some military practitioners have applied them. In doing so, this essay will propose principles of critical and creative thinking applicable to the military profession to provide a common vocabulary that describes the type of thinking we do. To expand and improve critical and creative thinking, military professionals need a common vocabulary that accurately describes the very thinking we are to expand and improve on.

- Sir Ken Robinson
  - Sir Ken Robinson: Do schools kill creativity?, a TED.com video, 2006 - EXCELLENT 20 minutes

        - Sir Ken Robinson makes an entertaining and profoundly moving case for creating an education system that nurtures (rather than undermines) creativity.
    - Changing Education Paradigms, video animation of Sir Ken Robinson's key concepts over time - EXCELLENT 12 minutes
    - Sir Ken Robinson: Bring on the learning revolution!, a TED.com video, 2010 follow-up to the 2006 talk - EXCELLENT 20 minutes
        - In this poignant, funny follow-up to his fabled 2006 talk, Sir Ken Robinson makes the case for a radical shift from standardized schools to personalized learning -- creating conditions where kids' natural talents can flourish.
    - Sir Ken Robinson: How to escape education's death valley , a TED.com video, 2013, from the TED TV special on education
        - Sir Ken Robinson outlines 3 principles crucial for the human mind to flourish -- and how current education culture works against them. In a funny, stirring talk he tells us how to get out of the educational "death valley" we now face, and how to nurture our youngest generations with a climate of possibility.
        - "There are three principles on which human life flourishes, and they are contradicted by the culture of education under which most teachers have to labor and most students have to endure."
            - "The first is this, that human beings are naturally different and diverse."
                - Education under No Child Left Behind is based on not diversity but conformity. What schools are encouraged to do is to find out what kids can do across a very narrow spectrum of achievement.
            - "The second principle that drives human life flourishing is curiosity."
                - So in place of curiosity, what we have is a culture of compliance. Our children and teachers are encouraged to follow routine algorithms rather than to excite that power of imagination and curiosity.
            - "And the third principle is this: that human life is inherently creative."
                - We all create our own lives through this restless process of imagining alternatives and possibilities, and what one of the roles of education is to awaken and develop these powers of creativity. Instead, what we have is a culture of standardization.

- Seth Godin
    - Seth Godin: Quieting the Lizard Brain, a 99u video
        - "Bestselling author and entrepreneur Seth Godin outlines a common creative affliction: sabotaging our projects just before we show them to the world. Godin targets our "lizard brain" as the source of these primal doubts, and implores us to "thrash at the beginning" of projects so that we can ship on time and on budget."
        - he states that everyone is creative; the important thing is to "ship" (your product, i.e., do something with your idea)
    - Seth Godin: How to get your ideas to spread - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "In a world of too many options and too little time, our obvious choice is to just ignore the ordinary stuff. Marketing guru Seth Godin spells out why, when it comes to getting our attention, bad or bizarre ideas are more successful than boring ones"

- other TED.com videos - most are 6-15 minutes
    - Matt Ridley: When ideas have sex - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "At TEDGlobal 2010, author Matt Ridley shows how, throughout history, the engine of human progress has been the meeting and mating of ideas to make new ideas. It's not important how clever individuals are, he says; what really matters is how smart the collective brain is.
        - Matt Ridley argues that, through history, the engine of human progress and prosperity has been, and is, "ideas having sex with each other."
    - Erik Brynjolfsson: The key to growth? Race with the machines - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "As machines take on more jobs, many find themselves out of work or with raises indefinitely postponed. Is this the end of growth? No, says Erik Brynjolfsson -- it's simply the growing pains of a radically reorganized economy. A riveting case for why big innovations are ahead of us … if we think of computers as our teammates. Be sure to watch the opposing viewpoint from Robert Gordon."
    - Robert Gordon: The death of innovation, the end of growth - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "The US economy has been expanding wildly for two centuries. Are we witnessing the end of growth? Economist Robert Gordon lays out 4 reasons US growth may be slowing, detailing factors like epidemic debt and growing inequality, which could move the US into a period of stasis we can't innovate our way out of. Be sure to watch the opposing viewpoint from Erik Brynjolfsson."
    - Elizabeth Gilbert: Your elusive creative genius - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Elizabeth Gilbert muses on the impossible things we expect from artists and geniuses -- and shares the radical idea that, instead of the rare person "being" a genius, all of us "have" a genius. It's a funny, personal and surprisingly moving talk."
    - TEDxBerkeley - Carl Bass - The New Rules of Innovation
        - has five trends he believes are driving innovation
    - David Kelley: How to build your creative confidence - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Is your school or workplace divided into "creatives" versus practical people? Yet surely, David Kelley suggests, creativity is not the domain of only a chosen few. Telling stories from his legendary design career and his own life, he offers ways to build the confidence to create... (From The Design Studio session at TED2012, guest-curated by Chee Pearlman and David Rockwell.)"
    - Adam Savage: How simple ideas lead to scientific discoveries - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Adam Savage walks through two spectacular examples of profound scientific discoveries that came

from simple, creative methods anyone could have followed -- Eratosthenes' calculation of the Earth's circumference around 200 BC and Hippolyte Fizeau's measurement of the speed of light in 1849."
    - Regina Dugan: From mach-20 glider to humming bird drone - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "What would you attempt to do if you knew you could not fail?" asks Regina Dugan, then director of DARPA, the Defense Advanced Research Projects Agency. In this breathtaking talk she describes some of the extraordinary projects -- a robotic hummingbird, a prosthetic arm controlled by thought, and, well, the internet -- that her agency has created by not worrying that they might fail."
    - Steven Johnson: Where good ideas come from - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "People often credit their ideas to individual "Eureka!" moments. But Steven Johnson shows how history tells a different story. His fascinating tour takes us from the "liquid networks" of London's coffee houses to Charles Darwin's long, slow hunch to today's high-velocity web." - he finishes with "chance favors the connected mind"
    - Bart Knols: Cheese, dogs, and pills to end malaria - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "We can use a mosquito's own instincts against her. At TEDxMaastricht speaker Bart Knols demos the imaginative solutions his team is developing to fight malaria -- including limburger cheese and a deadly pill."
    - Edward Tenner: Unintended consequences - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Every new invention changes the world -- in ways both intentional and unexpected. Historian Edward Tenner tells stories that illustrate the under-appreciated gap between our ability to innovate and our ability to foresee the consequences."
    - Charles Leadbeater: The era of open innovation - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "In this deceptively casual talk, Charles Leadbeater weaves a tight argument that innovation isn't just for professionals anymore. Passionate amateurs, using new tools, are creating products and paradigms that companies can't."
        - "A researcher at the London think tank Demos, Charles Leadbeater was early to notice the rise of "amateur innovation" -- great ideas from outside the traditional walls, from people who suddenly have the tools to collaborate, innovate and make their expertise known."
    - Clay Shirky on institutions vs. collaboration - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "In this prescient 2005 talk, Clay Shirky shows how closed groups and companies will give way to looser networks where small contributors have big roles and fluid cooperation replaces rigid planning."
    - Howard Rheingold on collaboration - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Howard Rheingold talks about the coming world of collaboration, participatory media and collective action -- and how Wikipedia is really an outgrowth of our natural human instinct to work as a group."
    - Sunni Brown: Doodlers, unite! - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Studies show that sketching and doodling improve our comprehension -- and our creative thinking. So why do we still feel embarrassed when we're caught doodling in a meeting? Sunni Brown says: Doodlers, unite! She makes the case for unlocking your brain via pad and pen."

- Jonah Lehrer: The Science of Insight Creation, 40 min. video from Jonah Lehrer - contributing editor of *Wired* and author of *How We Decide*
    - "Science is getting harder. Finding notable, new facts is getting harder. So how can we increase our capacity for breakthroughs and insights? What can new disciplines like neuroscience teach us about the innovation process? Jonah Lehrer explores creativity from a scientific perspective and discusses questions such as why we have our best ideas in the shower."
    - talks about the "feeling of knowing" such as the tip of the tongue phenomenon
    - talks about why brainstorming doesn't work - cites studies showing that allowing criticism leads to 7 times the number of useful ideas 24 hours later after folks have had time to think on their own outside the group
    - we can all imagine more, if only we know how

- 21st Century Enlightenment, RSAnimate talk by Matthew Taylor - how the idea of a new enlightenment can help us meet the challenges we now face

- Innovate or Die: Innovation and Technology for Special Operations (local copy), by Spulak, JSOU Report 10-7, Dec 2010

- CreatingMinds.org - with principles, techniques, tools, etc.

- Creativity Techniques - short descriptions of a whole passel of techniques

- Roots of Innovation (local copy, 2.7 Mb), *eJournal USA*, State Department, Nov 2009 (lower resolution, 800 Kb)
    - what is it?
    - which cultures foster it?
    - the global geography of innovation
    - how do complementary skills help?
    - secrets of collaboration
    - 2009 innovation index by country ranking

- The Art of Design: a Design Methodology (local copy), by Banach, *Military Review*, Mar-Apr 2009

- Predicting Military Innovation, by Isaacson et al, RAND, 1999
    - Although military technology is increasingly available and affordable, not all states have the capacity to improve military effectiveness by acquiring hardware. Integrative difficulties — in command structures,

doctrine and tactics, training, and support — are common in the developing world, and many states will have to find some level of innovation to overcome such difficulties if they are to use military technologies effectively. This annotated briefing documents a research effort aimed at understanding and predicting how militaries may improve their battlefield effectiveness. The briefing first analyzes military innovation conceptually and then formulates a framework for predicting the likelihood of innovative success. The research synthesizes a broad literature on innovation and provides a useful tool for assessing future military developments.

- Brain and Creativity Institute, University of Southern California
  - The mission of the Brain and Creativity Institute is to gather new knowledge about the human emotions, decision-making, memory, and communication, from a neurological perspective, and to apply this knowledge to the solution of problems in the biomedical and sociocultural arenas.

- From Stone to Silicon: A Brief Survey of Innovation, by Husick, Foreign Policy Research Institute, Oct 2008 - top 25 innovations of all time

- Toward More Innovative Program Management (local copy), by Perino, in Defense *Acquisition Review* Journal, Feb-Mar 2005 - results of research into the science and psychology of innovation - using MBTI and FourSight assessment tools - includes formula for MBTI Creativity Index

- Stimulating Innovation (local copy), by Kostoff, Office of Naval Research
- Science and Technology Innovation (local copy), by Kostoff, Office of Naval Research - compares literature-based and workshop-based approaches for stimulating innovation

- Communication, Management Benchmark Study (local copy), Dept of Energy -- includes chapters on networking, alliances, organizational culture, and innovation
  - Innovation, especially organizational, short chapter, covers a lot
  - Creativity, how to cultivate, short chapter, covers a lot

- Leadership: Creativity and Innovation, by William Klemm, from AU-24, GOOD broad coverage of ideas
- Innovation and the Military Mind, by Air Vice-Marshal R. A. Mason, from AU-24
- The Creative Leader, by Kendall, from AU-24

- Innovation: from Getting It to Getting It Done (local copy) - briefing by Kao, from OSD Transformation website

- Leadership and Influence (local copy), self-study course from FEMA

- Leadership: Strategies for Personal Success - Student Manual (local copy), FEMA
  - Managing Multiple Roles for the Company Officer
  - Creativity
  - Enhancing Your Personal Power Base
  - Ethics
- Leadership: Strategies for Personal Success - Instructor Guide (local copy), FEMA

- Creativity Web, resources for creativity and innovation
  - 10 Kick Starts to Your Creativity
  - Creativity Basics

- The Serendipity Equations, by Figueiredo and Campos, posted by the Naval Research Lab
- Searching the Unsearchable: Inducing Serendipitous Insights, by Campos and Figueiredo, posted by the Naval Research Lab

- Beyond Productivity: Information Technology, Innovation, and Creativity, National Academies Press, 2003 - addresses issues such as "what makes people creative" and "how creative people work"

- The International Center for Studies in Creativity at Buffalo State College
  - Creativity Based Information Resources (CBIR) online, searchable database

- Creativity in the Workplace, links to resources

- Creativity for Life, living creatively

- *The Innovation Journal*
- American Creativity Association
- European Association for Creativity and Innovation (EACI)

Emotional Intelligence Top

- Emotional Intelligence - Implications for All U.S. Air Force Leaders, by Latour and Hosmer, in *Air & Space Power Journal*

- Gov Online Learning Center - with courses on ethics, management, risk assessment, decision-making, critical thinking, problem-solving, strategic planning, etc.
  - The Business Case for Emotional Competence (local copy) - 14 statements, with supporting research
  - Type in **leadership** for Online Leadership Courses at Gov Online Learning Center
  - Type in **emotional intelligence** for Online Emotional Intelligence Courses at Gov Online Learning Center

- Consortium for Research on Emotional Intelligence in Organizations

- "Leadership That Gets Results," by Daniel Goleman, in *Harvard Business Review*,
  - describes six leadership styles: Coercive, Authoritative, Affiliative, Democratic, Pacesetting and Coaching

- Managing with Emotional Intelligence, at LeadershipAdvantage.com

- Emotional Intelligence As a Leadership Skill - course at the Federal Executive Institute
- From Army Management Staff College (AMSC), Dr Ursula Lohmann
  - Emotional Intelligence Sets Apart Good Leaders (local copy) - a spiffy Powerpoint presentation
  - Leadership and Emotional Intelligence (local copy)
    - Should emotional intelligence play a role in the workplace? -- some questions to stimulate discussion
  - Emotional Intelligence Resource List (local copy)
- Emotional Competence and Leadership (local copy), USCG one-page summary
- EQ.org directory of internet Emotional Intelligence sites
- Emotional Intelligence at HayGroup.com - just an intro to the concept
- Emotional Intelligence Test - one example
- EQ Emotional Intelligence tests online - mixed quality, try several and glean tidbits from the narratives

Brainstorming Top

- See also Kipling for six places to start - what, why, when, how, where, and who
- Jonah Lehrer: The Science of Insight Creation, 40 min. video from Jonah Lehrer - contributing editor of *Wired* and author of *How We Decide*
  - "Science is getting harder. Finding notable, new facts is getting harder. So how can we increase our capacity for breakthroughs and insights? What can new disciplines like neuroscience teach us about the innovation process? Jonah Lehrer explores creativity from a scientific perspective and discusses questions such as why we have our best ideas in the shower."
  - talks about the "feeling of knowing" such as the tip of the tongue phenomenon
  - talks about why brainstorming doesn't work - cites studies showing that allowing criticism leads to 7 times the number of useful ideas 24 hours later after folks have had time to think on their own outside the group
  - we can all imagine more, if only we know how
- Brainstorming Techniques (local copy), from the CDC
- Rules for Brainstorming (local copy), from the U.S. Army Corps of Engineers
- The Idea Center, with IdeaFisher software, commercial brainstorming tool, with modules for strategic planning, speeches/presentations, conflict resolution, and creative writing

Memory Skills Top

- Joshua Foer: Feats of memory anyone can do - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "There are people who can quickly memorize lists of thousands of numbers, the order of all the cards in a deck (or ten!), and much more. Science writer Joshua Foer describes the technique -- called the memory palace -- and shows off its most remarkable feature: anyone can learn how to use it, including him."
- Tools for Improving Your Memory, from Mind Tools
- Memory Techniques (local copy), from the U.S. Air Force Academy registrar
- more resources, from universities

Concept Maps Top

- Concept Maps, a method to represent information visually - online resources
- Theory Underlying Concept Maps and How to Construct Them, by Joseph D. Novak, Cornell University

Cognitive Skills Top

- Mensa Workout, pratice mental test by Mensa International
- CriticalThinking.org - with 35 Dimensions of Critical Thought, GOOD series of short articles on affective and cognitive strategies, incl such items as listening critically
- The Creative Learning Exchange, swapping materials between creative teachers
- Explorations in Learning & Instruction: The Theory Into Practice Database, a GOOD place to get overview of a buncha theories/methods
- Read More Quickly and Effectively, by Mind Tools

Cognitive Bias Top

- See also fallacies in logic
- Changing Minds in the Army: Why It's So Difficult and What To Do About It (local copy), by Gerras and Wong, U.S. Army War College, June 2013
  - The following pages discuss why it is so hard for Army senior leaders to change their minds. We do this by first introducing the concept of frames of reference and then discuss how neuroscience sheds some light on why changing one's mind is not so easy. We then examine the role of organizational variables on this process. Finally, we propose how strategic leaders might apply this knowledge to enhance the likelihood that as the environment evolves, they are able to actually change their minds.
  - In large hierarchical organizations such as the Army, consistency of thought is the norm, and not the exception. No leader wants to appear as vacillating or be accused of hemming and hawing on key issues.

Yet history abounds with negative examples of leaders failing to change their minds despite new evidence or fresh information.

- Thinking in a Foreign Language Makes Decisions More Rational, by Keim, in *Wired* online journal, Apr 2012
  - A series of experiments on more than 300 people from the U.S. and Korea found that thinking in a second language reduced deep-seated, misleading biases that unduly influence how risks and benefits are perceived.
  - The researchers believe a second language provides a useful cognitive distance from automatic processes, promoting analytical thought and reducing unthinking, emotional reaction.

- Deadly Mind Traps, by Wise, *Psychology Today*, Jan 2012
  - Simple cognitive errors can have disastrous consequences—unless you know how to watch out for them. [The article has specific examples of each of the errors below.]
    - Redlining. Anytime we plan a mission that requires us to set a safety parameter, there's a risk that in the heat of the moment we'll be tempted to overstep it.
    - The Domino Effect. "In stressful situations, you see a failure in the working memory, which is involved in inhibiting impulses," says Sian Beilock, a psychology professor at the University of Chicago. "People lose the ability to think about the long-term consequences of their actions."
    - Situational Blindness. Full situational awareness requires incorporating outside information into a model of your environment, and using that model to predict how the situation might change. If all you're doing is following the line of the GPS, and it turns out to be wrong, you'll be completely clueless about what to do next.
    - Double or Nothing. Daniel Kahneman and Amos Tversky first pointed out back in 1979, we tend to avoid risk when contemplating potential gains but seek risk to avoid losses. For instance, if you offer people a choice between a certain loss of $1,000 and a 50-50 chance of losing $2,500, the majority will opt for the riskier option, to avoid a definite financial hit.
    - Bending the Map. Such errors of overconfidence are due to a phenomenon psychologists call *confirmation bias*. "When trying to solve a problem or troubleshoot a problem, we get fixated on a specific option or hypothesis," explains Kring, "and ignore contradictory evidence and other information that could help us make a better decision."

- Heuristics and Biases in Military Decision Making (local copy), by Williams, in *Military Review*, Sep-Oct 2010
  - Fortunately, some have come to see the shortcomings of the classical MDMP process. It is illsuited for the analysis of problems exhibiting high volatility, uncertainty, complexity, and ambiguity.
  - When combining hindsight bias and retrievability biases, we potentially fail to guard against an event popularized euphemistically as a *black swan*.
  - Instead of the usual striving toward a “best practices” methodology, which is also full of potential heuristic biases, reflective practice calls for “valuing the processes that challenge assimilative knowledge (i.e. continuous truth seeking) and by embracing the inevitable conflict associated with truth seeking.”

- Ben Goldacre: Battling bad science, a talk from TED.com (but you may need to watch it on YouTube if the TED.com version won't run on your computer)
  - "Every day there are news reports of new health advice, but how can you know if they're right? Doctor and epidemiologist Ben Goldacre shows us, at high speed, the ways evidence can be distorted, from the blindingly obvious nutrition claims to the very subtle tricks of the pharmaceutical industry."

- Criminal Investigation Failures: Avoiding the Pitfalls (Part One) (local copy), by Rossmo, in *Law Enforcement Bulletin*, Sep 2006 - discusses various types of cognitive bias
  - Criminal Investigation Failures: Avoiding the Pitfalls (Part Two) (local copy), by Rossmo, in *Law Enforcement Bulletin*, Oct 2006 - discusses probability errors and organizational traps

- Curing Analytic Pathologies: Pathways to Improved Intelligence Analysis (local copy), by Cooper, CIA Center for the Study of Intelligence, Dec 2005
  - The Analytic Pathologies framework yields four insights that are crucial both to accurate diagnosis and to developing effective remedies. First, the framework enables analysts to identify individual analytic impediments and determine their sources. Second, it prompts analysts to detect the systemic pathologies that result from closely-coupled networks and to find the linkages among the individual impediments. Third, it demonstrates that each of these networks, and thus each systemic pathology, usually spans multiple levels within the hierarchy of the Intelligence Community. Fourth, the framework highlights the need to treat both the systemic pathologies and the individual impediments by focusing effective remedial measures on the right target and at the appropriate level.

- Cognitive Biases listed at Wikipedia

- Psychology of Intelligence Analysis (local copy), by Heuer, 1999, for CIA
-- very good examination of many elements of critical thinking, with examples (PDF version)
  - Check out Part III - Cognitive Biases

- Countering Terrorism: Integration of Practice and Theory (local copy), overview of conference at FBI Academy, Feb 2002
  - from Appendix 8: Psychology of Bias

    These investigators found that *there is a general bias, based on both innate predispositions and experience, in animals and humans, to give greater weight to negative events or attributes*. This is evident in four ways:

    (a) negative potency (negative entities are stronger than the equivalent positive entities),
    (b) steeper negative gradients (the negativity of negative events grows more rapidly with approach to them in space or time than does the positivity of positive events),
    (c) negativity dominance (combinations of negative and positive entities yield evaluations that are more negative than the algebraic sum of individual subjective evaluations would predict), and
    (d) negative differentiation (negative entities are more varied, yield more complex conceptual

representations, and engage a wider response repertoire).
The authors review this taxonomy, with emphasis on negativity dominance, including literary, historical, religious, and cultural sources, as well as the psychological literatures on learning, attention, impression formation, contagion, moral judgment, development, and memory. They suggest that one feature of negative events that make them dominant is that negative entities are more "contagious" than positive entities.

Baloney Detection Top

- See also cognitive bias
- Baloney Detection Kit, a video by Shermer, of *Skeptic* magazine
- The Fine Art of Baloney Detection, a written guide by Carl Sagan

Psychological Bias Top

- See also cognitive bias
- Tali Sharot: The optimism bias - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "Are we born to be optimistic, rather than realistic? Tali Sharot shares new research that suggests our brains are wired to look on the bright side -- and how that can be both dangerous and beneficial."
- Daniel Kahneman: The riddle of experience vs. memory - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "Using examples from vacations to colonoscopies, Nobel laureate and founder of behavioral economics Daniel Kahneman reveals how our "experiencing selves" and our "remembering selves" perceive happiness differently. This new insight has profound implications for economics, public policy -- and our own self-awareness."
  - "Widely regarded as the world's most influential living psychologist, Daniel Kahneman won the Nobel in Economics for his pioneering work in behavioral economics -- exploring the irrational ways we make decisions about risk."

Sensemaking Top

- David Moore
  - Sensemaking: A Structure for an Intelligence Revolution (local copy), by Moore, National Defense Intelligence College (NDIC), March 2011
    - Mindfulness, wicked problems, paradigm shifts, intuitive thinking, validation, intelligence rigor, limitations, and more
    - Sensemaking, whereby intelligence professionals would work with executive decisionmakers to explain data that are "sparse, noisy, and uncertain," requires an interpreter and experienced champion to bring about a practicable understanding and acceptance of the concept among intelligence practitioners. David Moore has accomplished that feat. Further, he, along with collaborators in chapters 5 and 7, demonstrate how sensemaking can be accomplished as a collaborative enterprise.
  - Critical Thinking and Intelligence Analysis (local copy, 1.4 Mb low res), by Moore, National Defense Intelligence College (NDIC) occasional paper no. 14, March 2007 (local copy, 12.1 Mb high res) - includes generic and intel-specific discussion, as well as an appendix which is the NSA's Critical Thinking and Structured Analysis Class Syllabus
    - NSA's Critical Thinking and Structured Analysis Class Syllabus - incudes plans for 10 classes, as well as a template for summarizing articles/readings
- A Sensemaking Experiment – Enhanced Reasoning Techniques to Achieve Cognitive Precision (local copy), by Klein et al, DODCCRP, 8 Feb 2007
- FOCUS: A Model of Sensemaking (local copy), by Sieck et al, ARI report, May 2007
- Sensemaking Symposium, Final Report (local copy), DODCCRP

Failure & Being Wrong - Why They Work Top

This was the pivotal insight of the Scientific Revolution: that the advancement of knowledge depends on current theories collapsing in the face of new insights and discoveries. In this model of progress, errors do not lead us away from the truth. Instead, they edge us incrementally toward it.
— Kathryn Schulz, in *Being Wrong: Adventures in the Margin of Error*

Leaders can let you fail and yet not let you be a failure.
--- General Stanley McChrystal

Science is always wrong. It never solves a problem without creating 10 more
--- George Bernard Shaw

Only those who will risk going too far can possibly find out how far one can go.
--- T. S. Eliot

The chief trick to making good mistakes is not to hide them — especially not from yourself. Instead of turning away in denial when you make a mistake, you should become a connoisseur of your own mistakes, turning them over in your mind as if they were works of art, which in a way they are. … The trick is to take advantage of the particular details of the mess you've made, so that your next attempt will be informed by it and not just another blind stab in the dark.
— Daniel Dennett, in *Intuition Pumps and Other Tools for Thinking*

- Kathryn Schulz: On being wrong - a TED talk (you may need to watch it on YouTube if TED videos are blocked)

- "Most of us will do anything to avoid being wrong. But what if we're wrong about that? "Wrongologist" Kathryn Schulz makes a compelling case for not just admitting but embracing our fallibility."

- Tim Harford: Trial, error and the God complex - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "Economics writer Tim Harford studies complex systems -- and finds a surprising link among the successful ones: they were built through trial and error. In this sparkling talk from TEDGlobal 2011, he asks us to embrace our randomness and start making better mistakes."

- Adapt: Why success always starts with failure, video by Tim Harford (book by the same title is on the Air Force Chief of Staff's 2012 Reading List)
  - Tim's Principles of Failure:
    #1 - Be willing to fail ... a lot
    #2 - Fail on a survivable scale
    #3 - Spot a failure and fix it, early

- Eddie Obeng: Smart failure for a fast-changing world - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "The world is changing much more rapidly than most people realize, says business educator Eddie Obeng -- and creative output cannot keep up. In this spirited talk, he highlights three important changes we should understand for better productivity, and calls for a stronger culture of “smart failure."

- Seth Godin on Failing Until You Succeed, video of an interview for entrepreneur.com
  - taking risks, challenging status quo, starting a business

Ignorance - a valuable resource Top

Thoroughly conscious ignorance is the prelude to every real advance in science.
--- James Clerk Maxwell

In an honest search for knowledge, you quite often have to abide by ignorance for an indefinite period.
--- Erwin Schroedinger

- see also failure and being wrong

- Stuart Firestein: The pursuit of ignorance - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "What does real scientific work look like? As neuroscientist Stuart Firestein jokes: It looks a lot less like the scientific method and a lot more like "farting around ... in the dark." In this witty talk, Firestein gets to the heart of science as it is really practiced and suggests that we should value what we don't know -- or "high-quality ignorance" -- just as much as what we know."

Red Teams, Red Teaming, Red Team Thinking Top

- University of Foreign Military and Cultural Studies (UFMCS)
  - The University of Foreign Military and Cultural Studies (UFMCS) at Fort Leavenworth is an Army-directed education, research, and training initiative for Army organizations, joint organizations, and other government agencies.
  - Red Teaming is a structured, iterative process, executed by highly trained, educated, and practiced team members that provides commanders an independent capability to fully explore alternatives to plans, operations, concepts, organizations, and capabilities in the context of the operational environment and from our partners’ and adversaries’ perspectives.
  - UFMCS educates Red Team Leaders, Members, and Practitioners; researches best practices for Red Teaming tactics, techniques, and procedures; and develops a reach-back capability to provide commanders and staffs alternative perspectives. Graduates of Leader and Member courses receive an additional skill identifier (ASI).
  - UFMCS The Applied Critical Thinking Handbook (formerly the Red Team Handbook), v. 8.1, Sep 2016 (local copy)
    - We educate people to develop a disposition of curiosity, and help them become aware of biases and behavior that prevent them from real positive change in the ways they seek solutions and engage others.
    - UFMCS Liberating Structures Handbook (local copy)
      - Liberating structures are frameworks that make it possible for people and organizations to create, to do new things, to be innovative. These are processes or rules that can be put in place to encourage people to be free, creative, and get results, rather than find themselves oppressed, constrained, confined, or powerless. For things to really change, structural elements need to change, too. Otherwise change is short-lived. Liberating structures are the forms that make it easy for people to be generative together and make a significant impact with their creativity.
    - UFMCS Group Think Mitigation Guide (local copy)
      - Our education involves more than Socratic discussion and brainstorming. We borrow techniques, methods, frameworks, and best practices from several sources and disciplines to create an education and practical application method that we find to be the best safeguard against individual and organizational tendencies toward biases, errors in cognition, and groupthink.
  - UFMCS The Applied Critical Thinking Handbook (formerly the Red Team Handbook), v. 7.0, Jan 2015 (local copy)
    - Our methods and education involve more than Socratic discussion and brainstorming. We believe that good decision processes are essential to good outcomes. To that end, our curriculum is rich in divergent processes, red teaming tools, and liberating structures, all aimed at decision support.

- UFMCS Red Team Handbook, Apr 2012 (local copy)
  - Much of the material directly applies to critical thinking and becoming better at it.
  - Each section can almost stand alone, and Section XI – Structured Analytic Techniques – has a large variety of tools/techniques for overcoming "mind-sets" – including "9 Step Cultural Methodology" and "String of Pearls" tool and "Analysis of Competing Hypotheses" and a passel of others.

- Reflections from a Red Team Leader (local copy), by Craig, in *Military Review*, Mar-Apr 2007

- Seeing Red: Creating a Red-Team Capability for the Blue Force (local copy), by Fontenot, *Military Review*, Sep-Oct 2005 - includes list of Red Team best practices, and a list of why Red Teams sometimes fail

Critical Thinking Top

> You want to have a mind that's open enough to accept radical new ideas,
> but not so open that your brains fall out.
> — Michael Shermer, editor of *Skeptic Magazine*
>
> Minds are like parachutes.
> They only function when they are open.
> — Richards Heuer
>
> Imagination is more important than knowledge.
> For knowledge is limited to all we now know and understand,
> while imagination embraces the entire world,
> and all there ever will be to know and understand.
> — Albert Einstein
>
> Not everything that can be counted counts,
> and not everything that counts can be counted.
> — Albert Einstein
>
> Trying to get people to reason in a way that is not natural for them
> is like trying to teach a pig to sing.
> You don't accomplish anything and you annoy the pig.
> — E. Jeffrey Conklin & William Weil
>
> Men believe what they prefer.
> — Francis Bacon
>
> If a man will begin with certainties, he shall end in doubts.
> But if he will be content to begin with doubts he shall end in certainties.
> — Francis Bacon
>
> My story is proud...The entry of truth with chalk to mark those minds which are capable to lodge and harbour it.
> — Francis Bacon
>
> For myself, I found that I was fitted for nothing so well as for the study of truth; as having a Mind nimble and versatile enough to catch the Resemblances of Things (which is the chief point) and at the same time steady enough to fix and distinguish their Subtler Differences; as being gifted by Nature with Desire to seek, patience to Doubt, fondness to Meditate, slowness to assert, readiness to consider, carefulness to dispose and set in order; and as being a man that neither affects what is new nor admires what is old, and that hates every kind of Imposture. So I thought my Nature had a kind of familiarity and Relationship with Truth.
> — Francis Bacon, *On the Interpretation of Nature*, 1603

- See red team thinking, especially the UFMCS Red Team Handbook

- See decision making

- See abductive, deductive, and inductive reasoning

- See design

- See argumentative and persuasive communication

- See media affecting decision making

- Improve Your Critical Thinking, resources at Coping.us - includes summaries/lists of many methods and theories
  1. Overview of Critical Thinking
  2. Critical Thinking Model of Problem Solving
  3. Watch out for Common Fallacies
  4. Online Resources for Improving Critical Thinking

- A Way to Teach Critical Thinking Skills so Learners Will Continue Using Them in Operations (local copy), by Griffin and McClary, in *Military Review*, Nov-Dec 2015
  - However, despite both instructors and students enjoying the critical thinking classes, many graduates were failing to think critically where it mattered most—on the job.
  - The first key is to establish an effective talent management program at the earliest possible opportunity, preferably from the start. Until an organization gets talent management right, with a high degree of person-job and person-organization fit, it will have very limited success with its other functions.
  - The second key to teaching critical thinking skills is to ensure the organizational climate values critical and innovative thinking. Building upon, and made possible by, a talent management program, an

organization demonstrates its commitment to these values by expecting and rewarding critical thinking and innovation.

- Two Faces of Critical Thinking for the Reflective Military Practitioner (local copy), by Paparone, in *Military Review*, Nov-Dec 2014
  - Critical thinking has become quite the catchphrase. Yet, there is little published in military circles demonstrating a philosophical examination of what critical thinking means; hence, my intent here is to start that conversation.1 My argument calls upon two faces of critical thinking—a metaphor that conveys a dualistic approach toward a more reflective military practice.

- Education for Critical Thinking (local copy), by Williams, in *Military Review*, Jan-Feb 2013
  - A better strategy for the Army's PME is to adopt an educational philosophy that focuses less on knowledge and content and more on the ability to question and argue. Critical thinking means the ability to construct and defend an argument using reason, applying intellectual standards of epistemic responsibility, and recognizing and countering logical fallacies as we see them in others and ourselves.
  - If we pay attention to our doctrine, this shift in thinking about professional education is a strategic imperative. We now accept as common knowledge that military operations defy rules, calling them instead "human endeavors, characterized by the continuous, mutual adaptation of give and take, moves, and countermoves among all participants." We agree that war is about identifying and solving ill-defined problems where experts can and do disagree on the range of solutions.
  - The problem is that we have a PME system that relies on an educational approach in which instructors are guides for each new class to rediscover the same hackneyed truths as their predecessors.
  - Mission command requires that we do more than allow for minor heresies. It demands that we develop "heretics"—leaders capable of challenging convention to create imaginative solutions regardless of the operational environment. An inquiry-based educational approach is the best way to develop these "heretics" because it is about questioning, and good questioners unequivocally make better thinkers.

- Army Leadership Development and Leadership (local copy), by Hinds and Steele, in *Military Review*, Jan-Feb 2012
  - Colonels, lieutenant colonels, and chief warrant fives were also surveyed about what skills were lacking for recent [PME] graduates. The most common response was "appropriate critical thinking and problem solving skills."

- Developing Creative and Critical Thinkers (local copy), by Allen and Gerras, in *Military Review*, Nov-Dec 2009
  - This article presents a definition of strategic thinking and then focuses on the two key antecedents of strategic thinking—creative and critical thinking—and presents the Army War College approach to educating students in these skills.
  - ... Given these challenges and obstacles, how do we make Army leaders better at creative and critical thinking? First, we must teach leaders the knowledge, skills, and terminology associated with thinking competencies. These are acquirable intellectual skills. As suggested earlier, the best way to teach thinking skills to Army leaders is to provide context-dependent skill development.

- Critical Thinking: What It Is and Why It Counts, by Facione, Santa Clara U. - 2015 update is available

- Thinking Critically about Critical Thinking: a Fundamental Guide for Strategic Leaders (local copy), by Gerras, U.S. Army War College

- Changing Army Culture Creating Adaptive and Critical Thinking Officer Corps (local copy), by Clarke, US Army War College, 15 Mar 2008

- Critical Thinking and the Development of Innovative Problem Solvers (local copy), by Drew, Naval War College, 14 Feb 2005
  - Integrating critical thinking into officer development requires the shifting of knowledge focused classes to self-study, teaching and using argument/concept mapping to reveal student's reasoning, and using the Universal Intellectual Standards as the basis of feedback on their reasoning.

- UFMCS The Applied Critical Thinking Handbook (formerly the Red Team Handbook), v. 8.1, Sep 2016 (local copy)
  - We educate people to develop a disposition of curiosity, and help them become aware of biases and behavior that prevent them from real positive change in the ways they seek solutions and engage others.
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    - Liberating structures are frameworks that make it possible for people and organizations to create, to do new things, to be innovative. These are processes or rules that can be put in place to encourage people to be free, creative, and get results, rather than find themselves oppressed, constrained, confined, or powerless. For things to really change, structural elements need to change, too. Otherwise change is short-lived. Liberating structures are the forms that make it easy for people to be generative together and make a significant impact with their creativity.
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        - Our methods and education involve more than Socratic discussion and brainstorming. We believe that good decision processes are essential to good outcomes. To that end, our curriculum is rich in divergent processes, red teaming tools, and liberating structures, all aimed at decision support.
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        - Each section can almost stand alone, and Section XI – Structured Analytic Techniques – has a large variety of tools/techniques for overcoming "mind-sets" – including "9 Step Cultural Methodology" and "String of Pearls" tool and "Analysis of Competing Hypotheses" and a passel of others.

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        - NSA's Critical Thinking and Structured Analysis Class Syllabus - incudes plans for 10 classes, as well as a template for summarizing articles/readings

    - Critical Thinking issue of *Military Intelligence Professional Bulletin* (local copy), July-September 2006
        - This issue of MIPB focuses on the integration of critical thinking and scientific inquiry throughout the military intelligence curricula.
        - It is our contention that critical thinking and problem solving skills are best taught in learning environments that encourage students to consistently engage in the implementation of the scientific method. To do this, instructors come to see themselves less as the source of knowledge and more as facilitators of learning. Although most courses within USAIC include practical exercises, many continue to include hours of lecture, followed by objective tests. Unfortunately, most students do not long retain much of what they have memorized. Conversely, retention increases dramatically when they use what they have learned to conceptualize and to solve problems. Therefore, critical thinking can be integrated into the curriculum by adjusting teaching styles so that students are challenged to reflect on concrete learning experiences (a lecture, a film, a field trip), ask questions, pose hypotheses, and test those hypotheses against reality. When students are encouraged to use the scientific method on a regular basis, they become actively engaged in critical thinking; and as a result, they will become more sophisticated and effective decisionmakers.

    - Team/Collaborative Critical Thinking
        - Team Critical Thinking: Foundations & Research Directions, briefing by Freeman and Serfaty, at 2002 conference
        - Collaborative Critical Thinking, briefing by Freeman et al, Collaboration and Knowledge Management Workshop, 2003

    - Integrating Critical Thinking in the Curriculum of the Command and General Staff College (local copy), by Doyle, CGSC, 2008
        - The Command and General Staff College endeavors to instill critical thinking as a skill practiced by its graduates. To this end the college has introduced the concept of critical thinking as a class within the core curriculum. Students must take a "critical thinking test" both before and after the block of core instruction, and numerous graphic training aids line the classroom walls in an attempt to reinforce these ideas. However, it remains questionable whether or not the concepts of critical thought, that are taught by the school, have made their way into the course work and class structure within the college. This thesis will contend that to create critical thinkers CGSC must incorporate the tenets of critical thinking throughout its curriculum and course design. Grading rubrics for papers and tests, exam questions written to steer answers in a certain "correct" direction all to a degree contradict the tenets of critical thought, yet exist within the course of study. Ideally, CGSC can stand as a seminal experience in the development of officers. An experience akin to that found in civilian graduate level education can be attained, but it will require a cultural revolution within the faculty to transition from a model based on training to a model based on education.

    - Psychology of Intelligence Analysis (local copy), by Heuer, 1999, for CIA -- very good examination of many elements of critical thinking, with examples (PDF version)
        - [from the introduction] Dick Heuer's writings make three fundamental points about the cognitive challenges intelligence analysts face:
            - The mind is poorly "wired" to deal effectively with both inherent uncertainty (the natural fog surrounding complex, indeterminate intelligence issues) and induced uncertainty (the man-made fog fabricated by denial and deception operations).
            - Even increased awareness of cognitive and other "unmotivated" biases, such as the tendency to see information confirming an already-held judgment more vividly than one sees "disconfirming" information, does little by itself to help analysts deal effectively with uncertainty.
            - Tools and techniques that gear the analyst's mind to apply higher levels of critical thinking can substantially improve analysis on complex issues on which information is incomplete, ambiguous, and often deliberately distorted. Key examples of such intellectual devices include techniques for structuring information, challenging assumptions, and exploring alternative interpretations.

    - Curing Analytic Pathologies: Pathways to Improved Intelligence Analysis (local copy), by Cooper, CIA Center for the Study of Intelligence, Dec 2005
        - The Analytic Pathologies framework yields four insights that are crucial both to accurate diagnosis and to developing effective remedies. First, the framework enables analysts to identify individual analytic impediments and determine their sources. Second, it prompts analysts to detect the systemic pathologies that result from closely-coupled networks and to find the linkages among the individual impediments. Third, it demonstrates that each of these networks, and thus each systemic pathology, usually spans multiple levels within the hierarchy of the Intelligence Community. Fourth, the framework highlights the need to treat both the systemic pathologies and the individual impediments by focusing effective remedial measures on the right target and at the appropriate level.

- Thinking and Writing: Cognitive Science and Intelligence Analysis (local copy), by Sinclair, CIA Center for the Study of Intelligence, Feb 2010 revision of 1984 monograph
  - We are, in fact, better at generating problems than at solving them. Rarely can we say unequivocally that we have solved a problem, particularly if it is a hard one. Rather we keep plugging away at it heuristically. Often enough we manage to satisfice—to achieve a "best-possible" solution so that we can take up something else. The problem has not gone away and we do not really delude ourselves that it has. But being realists (i.e., heuristic individuals to the core), we accept the results and live with them—recognizing that sometime we may find ourselves returning to the problem once more. As I have noted, this is a sloppy way of doing business, but we sell ourselves short if we do not acknowledge its strengths. It deals as well as anything yet developed with the fact, to use Jerome Bruner's words, that our "ability to deal with knowledge is hugely exceeded by the potential knowledge contained in man's environment."

- A Mini-Guide for Teaching Critical Thinking, by Bean and Markham, Ira C. Eaker College for Professional Development (ECPD), 2008
  - This guide is designed to provide general information, strategies and a step-by-step process on Critical Thinking, two lesson plans which can be helpful in effectively teaching Critical Thinking, a case study which lends itself to thinking critically to come to a desirable resolution, and lastly, some recommended reading resources for providing a foundation to and assisting instructors in the classroom and with student consultation.

- A Tradecraft Primer: Structured Analytic Techniques for Improving Intelligence Analysis (local copy), posted by CIA, March 2009
  - This primer highlights structured analytic techniques—some widely used in the private sector and academia, some unique to the intelligence profession. It is not a comprehensive overview of how intelligence officers conduct analysis. Rather, the primer highlights how structured analytic techniques can help one challenge judgments, identify mental mindsets, stimulate creativity, and manage uncertainty. In short, incorporating regular use of techniques such as these can enable one to structure thinking for wrestling with difficult questions.

- CIA Compendium of Analytic Tradecraft Notes (local copy) - "CIA has made this edition [1995] of the compendium available to the public to help shed light on how the Directorate of Intelligence meets the daily challenges of providing timely, accurate, and rigorous analysis to intelligence consumers"

- Critical Thinking: Plugging (or Moving) a Hole in Our Swiss Cheese (local copy), by Johns, Assistant U.S. Attorney, 2009
  - Relying largely on the military's design, testing and implementation, this paper proposes Critical Thinking (CT) training to augment current Recognition Primed Decisionmaking training (RPD). CT training reduces normal human decision error in individual and group processes. Individual CT can reduce or, in a specific case, close a hole in the Swiss Cheese model. In a group, CT can also move the hole out of alignment. Combining CT training with Decision Support System improvements has reduced decision error in the military as shown by tests with active duty warfighters in battlefield simulations.

- Critical Reasoning for Beginners, by the Faculty of Philosophy, University of Oxford - videos, audios, and slides (can play the audio while viewing the slides, and avoid downloading 600+ Mb videos)
  - In this six-week course delivered by Marianne Talbot, you will learn all about arguments, how to identify and evaluate them, and how not to mistake bad arguments for good.

- Critical Thinking - tools to test/measure
  - The Critical Thinking Rubric, Critical Thinking Project, Washington State University - assesses skill at each step of the problem solving process, including ability of individual to identify and consider influence by the context of the issue
    - Seven dimensions to be assessed:
      1. Identifies and summarizes the **problem/question** at issue (and/or the source's position).
      2. Identifies and presents the STUDENT'S OWN **hypothesis, perspective and position** as it is important to the analysis of the issue.
      3. Identifies and considers OTHER salient **perspectives and positions** that are important to the analysis.
      4. Identifies and assesses the key **assumptions**.
      5. Identifies and assesses the quality of **supporting data/evidence** and provides additional data/evidence related to the issue.
      6. Identifies and considers the influence of the **context** on the issue. [they list some sample contexts to consider]
      7. Identifies and assesses **conclusions, implications and consequences**.
  - Holistic Critical Thinking Scoring Rubric, by Facione and Facione
  - California Critical Thinking Skills Test (CCTST)
  - Test of Every Day Reasoning (TER)

- The Cognitive Bases of Intelligence Analysis (local copy, 6 Mb file), by Thompson et al, U.S. Army Research Institute for the Behavioral and Social Sciences, Jan 1984

- Critical Thinking For The Military Professional, by Guillot, in *Air & Space Power Chronicles*

- CRITO (local copy), a step-by-step method for creating a critical analysis essay, courtesy of Dr. David K. Johnson, Massachusetts College of Liberal Arts
  - **C** - State a **C**onclusion or claim
  - **R** - State **R**easons or evidence meant to convince the reader
  - **I** - Test the **I**nference, or argument
  - **T** - Test the **T**ruth of the R

- **O** - Construct the strongest imaginable **O**bjections, and respond to them

- Risk Perception & Strategic Decision Making: General Insights, a New Framework, and Specific Application to Electricity Generation Using Nuclear Energy (local copy), by Brewer, Sandia National Labs, Nov 2005 - some good generic discussion included, such as ten critical thinking processes, with examples for each

- Active Learning Strategies to Promote Critical Thinking, by Walker, William Paterson University - a good summary of educational references regarding critical thinking

- Training Critical Thinking for Tactical Command (local copy), NATO report, Apr 2004

- The Miniature Guide to Critical Thinking: Concepts & Tools, by R. Paul and L. Elder, The Foundation for Critical Thinking

- A Rulebook for Arguments, by Anthony Weston

- Strategies for Teaching Critical Thinking (local copy), an ERIC Digest

- CriticalThinking.org - with 35 Dimensions of Critical Thought, GOOD series of short articles on affective and cognitive strategies, incl such items as listening critically

- Evaluating Critical Thinking Skills (local copy), from U.S. Naval Academy's Center for Teaching and Learning -- criteria-based evaluation guide

- Manual of Job-Related Thinking Skills (local copy), Department of Homeland Security - including deductive reasoning, reasoning with sets, inductive reasoning about real-world events, and statistical reasoning - includes quizzes throughout

- How Critical Thinking Shapes the Military Decision Making Process (local copy), by Usry, Naval War College, 2004
  - A lack of Combatant Commander (COCOM) critical thinking in the Military Decision Making Process (MDMP) is a causal factor in military failure at the operational level. However, critical thinking can improve the MDMP of the COCOM. This paper analyzes the effects of critical thinking on the combatant commander's decision making process by: defining critical thinking; illustrating its impact on intuitive and analytical decisions; demonstrating barriers to critical thinking and proposing practical ways to use critical thinking in the MDMP.

- The Role of Rhetorical Theory in Military Intelligence Analysis - A Soldier's Guide to Rhetorical Theory (local copy), by Mills, AU Press

- Critical Thinking on the Web, "a directory of quality online resources"

- Developing Thinking Skills: Critical Thinking at the Army Management Staff College (AMSC) (local copy), by Eichhorn
- Assessing Curriculum via Critical Thinking (local copy, PDF, 300 kb), by Eichhorn, AMSC - includes various models, procedures, lists, etc.

- U.S. Army Research Institute (ARI) products - see also ARI decision making products
  - [from the ARI site]
    Army officers are increasingly required to operate in situations they have not previously encountered and for which they have not been trained. In these situations, the ability to critically think through a problem, rather than apply previously learned solutions and procedures, is crucial to Army success.

    This effort began in 2000, with the development of a theoretical model of critical thinking and the identification of eight high pay-off critical thinking skills for Army Battle Command.

    - Critical Thinking Training for Army Schoolhouse and Distance Learning (local copy), ARI Newsletter, August 2003 - "High Pay-off Skills to deal with the uncertain" - includes a **diagram of Conceptual Model of Critical Thinking** and expansion on the following "High Pay-off Critical Thinking Skills for Army Battle Command"
      - Seek a clear statement of the problem.
      - Recognize main point in a message.
      - Visualize plans to see if they achieve goals.
      - Construct a plausible story that ties all incidents together. ("...uncovering relationships, exploring alternative explanations of the information and keeping an open mind to detecting patterns")
      - Recognize fallibility and bias in own opinion.
      - Generalize from specific instances to broader classes.
      - Adopt multiple perspectives in interpreting events.
      - Determine when to seek more information.

  - Computerized Training in Critical Thinking (CT)2: A Skill-Based Program for Army Personnel (local copy), by Fischer and Riedel, ARI Report 1880, June 2008
    - Critical Thinking Training for Army Officers - Volume One: Overview of Research Program (local copy), by Fischer and Riedel, ARI Report 1881, June 2008
    - Critical Thinking Training for Army Officers - Volume Two: A Model of Critical Thinking (local copy), by Fischer and Spiker and Riedel, ARI Report 1882, Feb 2009
    - Critical Thinking Training for Army Officers - Volume Three: Development and Assessment of a Web-Based Training Program (local copy), by Fischer and Spiker and Riedel, ARI Report 1883, Feb 2009

  - Training Critical Thinking Skills for Battle Command (local copy), Workshop Proceedings
  - Training Critical Thinking for the Battlefield - Vol I - Basis in Cognitive Theory and Research (local

copy)
- Training Critical Thinking for the Battlefield - Vol II - Training System and Evaluation (local copy)
- A Cognitive Framework for Battlefield Commanders' Situation Assessment (local copy) , Ft Leavenworth Field Unit

- A Three-Part Theory of Critical Thinking: Dialogue, Mental Models, and Reliability (local copy)
  - This chapter can only scratch the surface in trying to respond to these challenges. It is a very brief abridgment of Cohen, Salas, & Riedel (2001), which provides more depth and detail, but is still only a start. The research had two main goals: First, to draw a map that links disparate regions of the critical thinking field, and second, to use the map to navigate toward a more insightful theory of critical thinking, which will support the development more effective methods for improving it in Army battlefield command teams.
  - The essence of our theory is that critical thinking skill is exemplified by *asking questions about alternative possibilities in order to achieve some objective*. Asking and answering questions is a skill of *dialogue*. Alternative possibilities are represented by *mental models*. A process of questioning mental models is adopted because of its *reliability* for achieving the purposes of the participants within the available time.

- Conceptualizing Multicultural Perspective Taking Skills (local copy), by Rentsch et al, ARI report, Nov 2007
- Program Evaluation Metrics for U.S. Army Lifelong Learning Centers (LLCs): Extension to Military Operational Specialty(MOS)-Based LLCs (local copy), by Cianciolo, ARI report, May 2008
- Building Cultural Capability for Full-Spectrum Operations (local copy), by Abbe, ARI report, Jan 2008
- Cross-Cultural Competence in Army Leaders: A Conceptual and Empirical Foundation (local copy), by Abbe et al, ARI report, Oct 2007
- FOCUS: A Model of Sensemaking (local copy), by Sieck et al, ARI report, May 2007
- Performance in Non-Face-to-Face Collaborative Information Environments (local copy), by Schaab et al, ARI report, Jan 2007
- Leader Experience and the Identification of Challenges in a Stability and Support Operation (local copy), by Ben-Yoav Nobel et al, ARI report, July 2006
- Developing Adaptive Proficiency in Special Forces Officers (local copy) - "focuses particularly on the topics of mental adaptability, interpersonal adaptability, and leading an adaptable team"
- Overview of Practical Thinking Instruction for Battle Command (local copy)
- Distance Learning: A Way of Life-Long Learning (local copy), by Belanich et al, Army Research Institute (ARI) Special Report 63, Sep 2005
- Practical Thinking - Innovation in Battle Command Instruction (local copy)
- Toward an Understanding of Team Performance and Team Cohesion Over Time Through the Lens of Time Series Analysis (local copy), by McIntyre et al, ARI Research Note 2003-07
- Tacit Knowledge and Practical Intelligence: Understanding the Lessons of Experience (local copy), by Hedlund et al, ARI Research Note 2003-04
- Tacit Knowledge in the Workplace (local copy - warning, 12 Mb file), by Sternberg et al, ARI report, Mar 1999
- Developing Effective Military Leaders: Facilitating the Acquisition of Experience-Based Tacit Knowledge (local copy), by Matthew et al, ARI report, Apr 2005
- The Influence of Trainee Gaming Experience and Computer Self-Efficacy on Learner Outcomes of Videogame-Based Learning Environments (local copy), by Orvis et al, ARI report, June 2005
- Task Difficulty and Prior Videogame Experience: Their Role in Performance and Motivation in Instructional Videogames (local copy), by Orvis et al, ARI report, June 2007
- Exploring the Interaction of Implicit and Explicit Processes to Facilitate Individual Skill Learning (local copy), by Sun and Mathews, ARI report, May 2005
- Utility of Game Instructions (local copy), by Chen, ARI report, Apr 2003
- Carnegie Hall: An Intelligent Tutor for Command-Reasoning Practice Based on Latent Semantic Analysis (local copy)
- An Overview of Automaticity and Implications for Training the Thinking Process (local copy)
- Recognition-Primed Decision Strategies: First-Year Interim Report (local copy), by Klein and Crandall, ARI Research Note 90-91, 1990
- Descriptive Models of Military Decision Making (local copy), by Klein et al, ARI Research Note 90-93, 1990
- Advanced Team Decision Making: A Developmental Model (local copy), by Zsambok, Klein et al, ARI publication of research done for ICAF, Aug 1992
  - Based on our observations of numerous tactical and strategic decision making teams, and on a review of relevant literature, Klein Associates derived three key components of advanced team decision making: team self identity, team conceptual level, and team self monitoring. The model contains ten key behaviors critical to team development in these components.
- Training Metacognitive Skills for Problem Solving (local copy), by Geiwitz, ARI Research Note 95-03, Nov 1994

- Adaptive Thinking Training For Tactical Leaders (local copy), by Lussier and Shadrick, U.S. Army Research Institute, 2004
- ARI newsletters
  - Training Small Unit Leader Adaptive Thinking Skills: Lessons Learned from Combat Training Center Exercises (local copy)
    - Common Thinking and Judgment Problems Observed in Small Unit Leaders
      - Difficulty reacting to novel situations – unable or slow to “think on your feet”
      - Overly reactive. Difficulty in thinking like the enemy
      - Focused on making quick decisions before fully analyzing the situation
      - Inadequate monitoring of the situation or responding to cues in the environment
      - Difficulty translating orders from higher echelons into actions
      - Tunnel vision
      - Overly focused on distracters; not on the big picture
      - Difficulty shifting roles (e.g., combat to mediation within the same mission)

        - Limited cultural awareness and necessary communication skills (specifically in dealing with civilians)
    - Critical Thinking as Dialogue: a New Approach to Training Critical Thinking (local copy), ARI Newsletter, October 2004 (whole issue (3 Mb))
    - Critical Thinking Training for Army Schoolhouse and Distance Learning (local copy), ARI Newsletter, August 2003 - "High Pay-off Skills to deal with the uncertain" - includes a **diagram of Conceptual Model of Critical Thinking** and expansion on the "High Pay-off Critical Thinking Skills for Army Battle Command"
    - Training Adaptive Leaders (local copy), ARI Newsletter, May 2003 - "train a performance - a thinking performance" - using the *Think Like a Commander* vignettes to improve ability to identify critical information
    - Tacit Knowledge for Military Leadership (local copy), ARI Newsletter, Spring 2001 - "Tacit knowledge scores, a better predictor of leadership effectiveness"
    - Training Critical Thinking Skills for Battle Command: How to Think, Not What to Think (local copy), ARI Newsletter, Spring 2001 - "Improve critical thinking to improve battle command tactical performance"
    - Training and Assessment of Decision-Making Skills in Virtual Environments (local copy), ARI Newsletter, Spring 2001 - "This research showed a linkage between decision-making and situation awareness"

- Critical Logistics Thinking Skills (local copy), by Dehrer, for U.S. Army Logistics Management College

- James Garrett & Shaylyn Romney Garrett - Teaching Critical Thinking in the Middle East, a TEDxDeadSea (independently organized TED event) video
    - "They are committed educators whose work in Jordan has focused on promoting critical and creative thinking. Their curriculum, called “Brain Camp,” is an educational intervention that focuses on building eight critical thinking skills with the aim of equipping the rising generation of Jordanians to become creative and effective problem solvers."

- Center for Critical Thinking, aka Critical Thinking Community
    - includes a library of short articles ranging from Socratic teaching to assessing thinking skills
    - Other resources include the following
    - Valuable Intellectual Traits
        - Intellectual Humility
        - Intellectual Courage
        - Intellectual Empathy
        - Intellectual Integrity
        - Intellectual Perseverance
        - Faith in Reason
        - Fairmindedness
    - Universal Intellectual Standards "are standards which must be applied to thinking whenever one is interested in checking the quality of reasoning" - "following are the most significant"
        - Clarity
        - Accuracy
        - Precision
        - Relevance
        - Depth
        - Breadth
        - Logic

- Dartmouth Writing Program support materials - including development of argument

- Fundamentals of Critical Reading and Effective Writing

- Mind Mirror Projects: A Tool for Integrating Critical Thinking into the English Language Classroom (local copy), by Tully, in *English Teaching Forum*, State Department, 2009 Number 1

- Critical Thinking Across the Curriculum Project, Metropolitan Community College

- Mission: Critical, tutorial on critical thinking, San Jose State University
    - Main Menu, detailed
- Institute for Critical Thinking (ICT), Montclair State U.
- Graduate Program in Critical and Creative Thinking (CCT), U. of Mass. Boston

- Of the Liberty of Thought and Discussion, Chapter 2 from On Liberty, by John Stuart Mill

- Rudyard Kipling, from "The Elephant's Child" in *Just So Stories*
  I keep six honest serving-men
  (They taught me all I knew);
  Their names are What and Why and When
  And How and Where and Who.
  [ed. - answering those six questions is often a good place to begin - and "why" is usually the one that pushes your writing past the knowledge level and demonstrates/reveals your insights]

- Occam's Razor, published 1328 (also spelled Ockham)
    - also known as the Law of Parsimony or Principle of Economy or Principle of Simplicity
    - Principle from William of Occam (logician and Franciscan friar, c. 1285-1350 or 1280-1349) -- stating that given multiple theories to explain a set of observations the simplest explanation is to be preferred
    - "*Pluralitas non est ponenda sine neccesitate*" or "*non sunt multiplicanda entia praeter necessitatem*" - "Entities should not be multiplied unnecessarily."
    - "Never multiply explanations or make them more complicated than necessary. An explanation should be as simple and direct as possible"
    - Einstein's version -- "make things as simple as possible - but no simpler"
    - modern variation -- Keep It Simple Stupid (KISS)

- Sherlock Holmes
    - "I have already explained to you that what is out of the common is usually a guide rather than a

hindrance. In solving a problem of this sort, the grand thing is to be able to reason backward. That is a very useful accomplishment, and a very easy one, but people do not practise it much. In the everyday affairs of life it is more useful to reason forward, and so the other comes to be neglected. There are fifty who can reason synthetically for one who can reason analytically." [in A Study in Scarlet, 1887]

- "How often have I said to you that when you have eliminated the impossible, whatever remains, *however improbable*, must be the truth?" [in The Sign of Four, 1890]
- "That process," said I, "starts upon the supposition that when you have eliminated all which is impossible, then whatever remains, however improbable, must be the truth. It may well be that several explanations remain, in which case one tries test after test until one or other of them has a convincing amount of support." [in The Case Book of Sherlock Holmes, 1927]

- "It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts." [in The Adventures of Sherlock Holmes, 1892, "A Scandal in Bohemia"]

- "I ought to know by this time that when a fact appears to be opposed to a long train of deductions, it invariably proves to be capable of bearing some other interpretation." [in A Study in Scarlet, 1887]

- "Data! Data! Data!" he cried impatiently. "I can't make bricks without clay." [in The Adventure of the Copper Beeches, 1892]

- Maria Konnikova - The Scientific Method of the Mind - an RSA video
  - "Maria Konnikova reveals how Sherlock Holmes can teach us to optimise not only our own everyday existence, but our broader contributions to society and the lives of those around us."

- Applying the Science of Learning: Using the Principles of Cognitive Psychology To Enhance Teaching and Learning (local copy), testimony before Congress by Halpern

- Promoting Critical Thinking In Professional Military Education, an Air University research paper
  - Appendix A - Gubbin's Matrix of Thinking Skills - for problem solving, decision making, inferences, divergent thinking, and evaluative thinking
  - Appendix B - Example Affective Behaviors - in approach to life in general and specific issues
  - Appendix C - Example Critical Thinking (CT) Standards - including feedback to students
  - Appendix D - Example CT Elective Syllabus - 15 topics for learning

- Improving Leadership through Better Decision Making: Fostering Critical Thinking, an Air University research paper
  - Appendix A discusses the Watson-Glaser Critical Thinking Appraisal - which is composed of a series of five tests
    - inference test - "gauges ones' ability to discern the degree of truth or falsity of inferences drawn from the data that you are given"
    - recognition of assumptions test - samples the "ability to recognize unstated assumptions in statements"
    - deduction test - "samples the ability to reason properly when given a statement of premise; to recognize the relation of implication between propositions"
    - interpretation test - samples the "ability to weigh evidence and make valid generalizations"
    - evaluation of arguments test - "samples the ability to distinguish strong and relevant arguments from ones which are weak or irrelevant"

- Critical Thinking I, lesson plan at SAMS, Leavenworth (local copy)
- Critical Thinking II, lesson plan at SAMS, Leavenworth (local copy)

- Collaborative Learning Enhances Critical Thinking, article by Gokhale

- Articles on Critical Thinking, annotated bibliography

- Logic Tutor, by Green - FREE online tutorial system on logic

- **Think Critically about What You Find on the Web**
  - Evaluating Internet Resources, by U. Albany Libraries
  - Thinking Critically about Web Resources, from UCLA Library
  - ICYouSee Guide to Critical Thinking About What You See on the Web, from Ithaca College Library
  - Testing the Surf: Criteria for Evaluating Internet Information Resources, by Alastair Smith, posted by U. of Houston
  - Markham Nolan: How to separate fact and fiction online, a talk from TED.com (but you may need to watch it on YouTube if the TED.com version won't run on your computer)
    - "By the end of this talk, there will be 864 more hours of video on YouTube and 2.5 million more photos on Facebook and Instagram. So how do we sort through the deluge? At the TEDSalon in London, Markham Nolan shares the investigative techniques he and his team use to verify information in real-time, to let you know if that Statue of Liberty image has been doctored or if that video leaked from Syria is legitimate."

- **Write a Critical Book Review**
  - Numero Uno rule - ask the faculty/editor who'll be reading it for their requirements/expectations
  - Writing a Book Review, Purdue Online Writing Lab (OWL)
  - How to Write a Book Review, Google search
  - How to Write a Book Review, Los Angeles Valley College Library
  - How to Write a Book Review, Stauffer Library
  - Writing Book Reviews, U. of Waterloo Library
  - Writing Book Reports & Book Reviews, Internet Public Library

Science and Reason Top

You want to have a mind that's open enough to accept radical new ideas, but not so open that your brains fall out.
— Michael Shermer, editor of *Skeptic Magazine*

Even for the physicist the description in plain language will be a criterion of the degree of understanding that has been reached.
— Werner Karl Heisenberg

This was the pivotal insight of the Scientific Revolution: that the advancement of knowledge depends on current theories collapsing in the face of new insights and discoveries. In this model of progress, errors do no lead us away from the truth. Instead they edge us incrementally toward it.
— Kathryn Schulz, *Being Wrong: Adventures in the Margin of Error*

- See also critical thinking

- How Science Works (local copy), by Goodstein, in *Reference Manual on Scientific Evidence, Second Edition*, Federal Judicial Center, 2000 - compares Francis Bacon's Scientific Method, Karl Popper's Falsification Theory, Thomas Kuhn's Paradigm Shifts, and more

- Steps of the scientific method (from CDC site)
  1. Name the problem or question
  2. Form an educated guess (hypothesis) of the cause of the problem and make predictions based upon the hypothesis
  3. Test your hypothesis by doing an experiment or study (with proper controls)
  4. Check and interpret your results
  5. Report your results to the scientific community

- Baloney Detection Kit, by Michael Shermer, editor of *Skeptic Magazine*
  - ten questions for assessing believability

- Scientific Method Man, article in *Wired*, Sep 2004 - discussing "verifier approach" to problem solution, as used by Gordon Rugg
  - With the verifier approach, Rugg begins by asking experts to draw a mental map of their field. From there, he stitches together many maps to form an atlas of the universe of knowledge on the subject. "You look for an area of overlap that doesn't contain much detail," he says. "If it turns out there's an adjoining area which everyone thinks is someone else's territory, then that's a potential gap."
  - His approach is built on the observation, noted as far back as the 1970s, that experts tend to cut to the chase. In their zeal to get to an answer, they make many little mistakes. (A recent study of work published in *Nature* and *British Medical Journal*, for example, found that 11 percent of papers had serious statistical errors.) Experts unknowingly fudge logic to square data with their hypotheses. Or they develop blind spots after years of working in isolation. They lose their ability to take a broader view. If all this is true, he says, think of how much big science is based on flawed intuition.
  - The verifier method boils down to seven steps:
    - 1) amass knowledge of a discipline through interviews and reading;
    - 2) determine whether critical expertise has yet to be applied in the field;
    - 3) look for bias and mistakenly held assumptions in the research;
    - 4) analyze jargon to uncover differing definitions of key terms;
    - 5) check for classic mistakes using human-error tools;
    - 6) follow the errors as they ripple through underlying assumptions;
    - 7) suggest new avenues for research that emerge from steps one through six.

- Additional resources on the *Verifier Approach*

Socratic Method & Asking Questions Top

- The Socratic Method - Leveraging Questions to Increase Performance (local copy), by Patnode, in *Program Manager* journal, Defense Acquisition University, Nov-Dec 2002

- more resources on Socratic method

Air Force Smart Operations for the 21st Century (AFSO21) Top

- AFSO21 Fact Sheet

- For more AFSO21 guidance/handbooks/tools/reference/etc. go to the AF Portal and do a search for AFSO21

- Air Force leaders emphasize AFSO21, by Bergquist, Air University Public Affairs, 28 Sep 2009

- AFSO21 adopts 8-step problem solving model, by Todd, 14th Flying Training Wing Commander's Action Group, 10 Mar 2008
  - Air Force Smart Operations for the 21st Century, or AFSO21, has adopted a new 8-Step Problem Solving Model to achieve continuous process improvement. This model is based on the OODA Loop and will make it easier for Air Force members to eliminate waste in the workplace.

- Air Force Smart Operations for the 21st Century - Playbook, May 2008 - over 300 pages of tools for improvement, including the 8-step problem solving process
  - The eight steps are expanded starting on page B-1 (pdf page 15)
    - (1) Clarify and Validate the Problem (Observe)
    - (2) Break Down the Problem and Identify Performance Gaps (Observe)
    - (3) Set Improvement Targets (Orient)
    - (4) Determine Root Causes (Orient)
    - (5) Develop Countermeasures (Decide)
    - (6) See Countermeasures Through (Act)
    - (7) Confirm Results and Process (Act)

(8) Standardize Successful Processes (Act)

- USAF 8-Step Problem Solving Process template (AFD-090716-101.pdf) with expanded sub-steps and reference to additional tools

Process and Design Top

Everything should be made as simple as possible, but not simpler.
— Albert Einstein

A designer knows he has achieved perfection not when there is nothing left to add, but when there is nothing left to take away.
— Antoine de Saint-Exupéry

- See also art of design on military theory page

- Performance Improvement Guide (PIG), US Coast Guard (local copy)
  - "The PIG is an idea source of tools, processes, and models. Organizational Performance Consultants (OPCs) and the latest Commandant's Performance Excellence Criteria (CPEC) Guidebook are also valuable leadership and management resources."

- Design: Thinking not Process, by McCauley, *Small Wars Journal*, 15 Oct 2011
  - Senior officers capable of critical and creative thinking are needed more than ever to plan and conduct operations in strategic and operational environments that offer ever-changing uncertainties in increasingly complex conditions. Officers who have a broad body of knowledge gained through experience and extensive study and capable of identifying and evaluating potential military response options within the context of a grand strategy are necessary to achieve the goals of the nation. The development of such officers requires a shift in their extensive focus from the operational and tactical environments to the strategic environment. This is a tremendous undertaking given that by far one spends the majority of one's career at those lower levels of war and promotion to senior ranks relies upon excellence in tactical thinking and execution. The aim of the Chairman, Joint Chiefs of Staff, is to educate strategically minded officers with the ability to view military affairs in the broadest context.
  - This essay posits that integrating design as a process within JOPP is a shortsighted attempt to legislate thinking whereas the more appropriate option would be to develop officers capable of design thinking. To develop senior officers who possess the requisite worldview, critical and creative thinking must underpin the concept of design. Senior officers must understand the role constraints play within design and how the strategic environment is affected. Two accepted approaches in design thinking, analysis/synthesis and conjecture/analysis, could provide senior officers with the unique perspectives necessary for planning at all levels of war. In addition, the unique skills that specific personality types possess that make strategic-thinking and design thinking more inherently natural must be recognized and promoted.
  - Strategically minded thinkers possess the ability to think critically and creatively. To think critically, one needs the ability to break concepts or objects into simpler parts and understand the relationship and organization of the parts relative to the whole. To think creatively, one needs the ability to rearrange the components or ideas into a new whole; in other words, to produce something through imaginative skill. Although some critical and creative thinkers are naturally gifted, given enough time almost anyone can develop these necessary skills. Unfortunately, for the majority of senior military leaders, time is something that is not in vast supply. In fact, given the relatively short duration of time that senior officers spend operating in the strategic environment and the even shorter periods they serve in any one position, it is a natural desire to attempt to develop a checklist or shortcut that will guide these officers through the wicked problems rife within complex environments.

- "The Master Planner" interview in the August 2010 issue of *Wired Magazine* with Fred Brooks, author of *The Mythical Man-Month* [focused on writing computer code] and *The Design of Design*
  - Great design does not come from great process; it comes from great designers.
  - The critical thing about the design process is to identify your scarcest resource.
  - You have to make sure your whole team understands what scarce resource you're optimizing.
  - You build a quick prototype and get it in front of users to see what they do with it. You will always be surprised.
  - Edwin Land, inventor of the Polaroid camera, once said that his method of design was to start with a vision of what you want and then, one by one, remove the technical obstacles until you have it.
  - ... I once argued that every member of a team should be able to see the code of every other member, but it turns out that encapsulation works much better.

- DoD resources
  - DoD Instruction 5010.42 DoD-Wide Continuous Process Improvement (CPI)/Lean Six Sigma (LSS) Program
  - DoD Instruction 5010.43 Implementation and Management of the DoD-Wide Continuous Process Improvement/Lean Six Sigma (CPI/LSS) Program
  - Continuous Process Improvement/ Lean Six Sigma Guidebook
    - Continuous Process Improvement/ Lean Six Sigma Guidebook, revision 1, July 2008 (local copy) - updates the 2006 version

- USMC Continuous Process Improvement (CPI) Guidebook (local copy)

- US Navy Pacific Fleet's Handbook for Basic Process Improvement (BPI) (local copy)

Problem Solving Top

The one common experience of all humanity is the challenge of problems.
— R. Buckminster Fuller

I am enthusiastic over humanity's extraordinary and sometimes very timely ingenuities. If you are in a shipwreck and all the boats are gone, a piano top buoyant enough to keep you afloat may come along and

make a fortuitous life preserver. This is not to say, though, that the best way to design a life preserver is in the form of a piano top. I think we are clinging to a great many piano tops in accepting yesterday's fortuitous contrivings as constituting the only means for solving a given problem.
— R. Buckminster Fuller

If I had an hour to solve a problem and my life depended on the solution, I would spend the first 55 minutes determining the proper question to ask, for once I know the proper question, I could solve the problem in less than five minutes.
— Albert Einstein

Intellectuals solve problems; geniuses prevent them.
— Albert Einstein

We can't solve problems by using the same kind of thinking we used when we created them.
— Albert Einstein

The biggest problem in the world could have been solved when it was small.
— Witter Bynner

There is always an easy solution to every human problem—neat, plausible, and wrong.
— H.L. Mencken

If a problem has no solution, it may not be a problem, but a fact - not to be solved, but to be coped with over time.
— Shimon Peres

- See also crowd sourcing
- See also Decision Making
- See also Critical Thinking
- See also AFSO21
- School of Advanced Air and Space Studies (SAASS), Air University
- School of Advanced Military Studies (SAMS), U.S. Army
  - see example SAMS lesson plans, for critical thinking
- School of Advanced Warfighting (SAW), Marine Corps University
- Joint Advanced Warfighting School (JAWS), National Defense University
- Naval Operational Planner Course (NOPC), Naval War College
- Problem-Based Learning: Instructor Characteristics, Competencies, and Professional Development (local copy), by Cianciolo et al, for U.S. Army Research Institute (ARI), Research Report 1936, Jan 2011
  - Preparing Soldiers to learn from problem-solving experiences requires that Army instructional practices become more responsive to individual student need, better attuned to operational requirements, and more representative of social learning contexts. To help instructors achieve this goal, the principles for facilitating problem-based learning must be investigated and their implications for professional development explicated. In this research, the instructor characteristics and competencies required to implement problem-based learning were explored. Techniques for instructor professional development in civilian and military contexts then were examined to identify best practices.
- Why We Can't Solve Big Problems, by Pontin, in *MIT Technology Review*, vol. 115, no. 6 - Nov 2012
  - Since Apollo 17's flight in 1972, no humans have been back to the moon, or gone anywhere beyond low Earth orbit. No one has traveled faster than the crew of Apollo 10. (Since the last flight of the supersonic Concorde in 2003, civilian travel has become slower.) Blithe optimism about technology's powers has evaporated, too, as big problems that people had imagined technology would solve, such as hunger, poverty, malaria, climate change, cancer, and the diseases of old age, have come to seem intractably hard.
  - It's not true that we can't solve big problems through technology; we can. We must. But all these elements must be present: political leaders and the public must care to solve a problem, our institutions must support its solution, it must really be a technological problem, and we must understand it.
- Storytelling as an Instructional Method: Definitions and Research Questions (local copy), by Andrews et al, sponsored by AFRL, published in *The Interdisciplinary Journal of Problem-based Learning*, Fall 2009 - deals with problem-based instruction, scenario-based instruction, case-based instruction, and narrative-based instruction
- AFSO21 adopts 8-step problem solving model, by Todd, 14th Flying Training Wing Commander's Action Group, 10 Mar 2008
  - Air Force Smart Operations for the 21st Century, or AFSO21, has adopted a new 8-Step Problem Solving Model to achieve continuous process improvement. This model is based on the OODA Loop and will make it easier for Air Force members to eliminate waste in the workplace.
- see AFSO21 section for 8-step problem solving process and other tools
- The Four Horsemen of the Problem Solving Apocalypse (local copy), by Coppola, in *U.S. Army Medical Department Journal*, Jul-Aug 1997
- Decision Making and Problem Solving (local copy), from Army ROTC
- Innovative Problem Solving in USAF Officer PME Curriculum, ACSC research paper
- Problem Solving -- related theories

- Decision Making and Problem Solving (local copy), self-study course from FEMA
- Osborn-Parnes Creative Problem-Solving (CPS) process
  - Process explained, narrative format, from handout at Illinois Institute of Technology (IIT)
    - Six steps
      - Objective finding
      - Fact finding
      - Problem finding
      - Idea finding
      - Solution finding
      - Acceptance finding
  - Versions and Variations of CPS
  - Add Creativity to Your Decision Process, U. of N. Carolina
  - A Comparison and Integration of the Osborn/Parnes and the Ideation/TRIZ Models for Innovation, U. of N. Carolina
- Traditional Six-Step Problem Solving Process
  - Identify and Select the Problem
  - Analyze the Problem
  - Generate Potential Solutions
  - Select and Plan the Solution
  - Implement the Solution
  - Evaluate the Solution
- Influence of Anonymity in a Group Problem-Solving Environment, research paper, Air Force Institute of Technology (AFIT)
- Planning Primer, U.S. Army Corps of Engineers, 23 pages -- includes discussion of problem-solving process (local copy)
- Planning Manual, U.S. Army Corps of Engineers, 321 pages -- includes discussion of problem-solving process (local copy)
- Six-Step Problem Solving Process, as used by Army Corps of Engineers
  - Identifying problems and opportunities
  - Inventorying and forecasting conditions
  - Formulating alternative plans
  - Evaluating alternative plans
  - Comparing alternative plans
  - Selecting a plan
- Training Metacognitive Skills for Problem Solving (local copy), by Geiwitz, ARI Research Note 95-03, Nov 1994
- Techniques for Effective Decision Making, by Mind Tools
  - Brainstorming - Generating Options
  - Critical Path Analysis - Planning and Scheduling Complex Tasks
  - Decision Trees - Powerful Quantitative Analysis of Decision Impact
  - Force Field Analysis - Analysis of all Pressures For and Against Change
  - PMI - A Powerful Enhancement to Pros and Cons
  - SWOT Analysis - Analysing your Strengths, Weaknesses, Opportunities and Threats
- Problem Solving and Decision Making: Consideration of Individual Differences - Using the Myers-Briggs Type Indicator (MBTI), by Huitt

Wicked Problems Top

Some problems are so complex that you have to be highly intelligent and well informed just to be undecided about them.
— Laurence J. Peter

- See also sensemaking
- Battle Command: An Approach to Wickedness (local copy), by McHenry, School of Advanced Military Studies, May 2009
  - There are two broad approaches to addressing ill-structured problems. First, a problem-focused approach which prioritizes a robust knowledge of the environment from which the problem has emerged. Second, a solution-focused approach that emphasizes the power of proposing solutions as the vehicle to gain understanding of the ill-structured problem. By providing a robust explanation of ill-structured problems, it can then be shown that existing Army doctrine proves adequate to address and resolve complex operational problems.
- Command at the Edge of Chaos (local copy), by Schwartz, Naval War College, 28 May 2007
  - Traditional hierarchical military staff organizations at the operational level of command remain suited for executing status quo and slowly evolving military operations focused on simple problems. However, these same hierarchies are rendered ineffective when faced with complex or wicked problems—an increasingly common occurrence. Replacing traditional staff structures with flat, self-organizing networks at the operational level of command and war will allow commanders to efficiently synchronize vast resources and more effectively attack rapidly evolving, complex and wicked problems. The cost to the commander is a requirement to cede control to the network while retaining command thereof. This paper looks at the limitations of hierarchical organizations, the advantages of leveraging self-organizing networks in a contemporary military context, and how such networks should be created and commanded. Finally, the paper provides recommendations to operational

commanders concerning when and how to employ self-organizing networks within operational level staffs.

- How to Think**:** Wicked Problems, Reflections from Dr Jack, Combined Arms Center Blog, 11 Nov 2008
  - "The term “wicked problems” was coined by Horst Rittel and Melvin Webber in 1973 to describe problems in planning that defy analytical methods for solutions"
  - includes Rittle and Webber's 10 criteria for defining a "wicked problem" - with a brief description of each
  - "There are a number of key implications from the concept of “wicked problems.” One issue is that there must be constant framing and reframing of a wicked problem to identify the second and third order effects of a plan or operation. A great plan may be only treating a symptom and not the underlying causes of the problem – potentially making the situation worse. Constant reframing and assessment are necessary to identify this throughout planning and operations."
  - "Another issue with “wicked problems” is that there are frequently multiple problems and issues within a problem set. The tendency to identify a problem as a familiar and simple problem – looking for simple cause and effect relationship – may mask multiple problems and lead to wrong solutions."

- Wicked problem, entry in Wikipedia - includes descriptions of several strategies to cope witih wicked problems, and includes the following list of characteristics (from Ritchey, referring to Rittel and Webber)
  1. There is no definitive formulation of a wicked problem (defining wicked problems is itself a wicked problem).
  2. Wicked problems have no stopping rule.
  3. Solutions to wicked problems are not true-or-false, but better or worse.
  4. There is no immediate and no ultimate test of a solution to a wicked problem.
  5. Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial and error, every attempt counts significantly.
  6. Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan.
  7. Every wicked problem is essentially unique.
  8. Every wicked problem can be considered to be a symptom of another problem.
  9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution.
  10. The planner has no right to be wrong (planners are liable for the consequences of the actions they generate).

- Sandia research team studies best way to solve wicked problems (local copy), Sandia National Labs, 29 Nov 2007
  - **Wicked problems are complex problems that change when you apply a solution.**
  -
  - What’s the best way to solve a wicked problem — by working in a large group sharing ideas via the intranet or as individuals? That’s the question George S. Davidson and his research team at Sandia National Laboratories attempted to resolve this summer.
  - ...
  - “We were amazed at the length and quality of the responses, both from the people working as a group and those working individually,” Dornburg says. “People were very engaged, often writing long, detailed responses.”
  - She adds that what was most interesting is that the quality of ideas from the people responding as individuals was “significantly better across all three quality ratings.”
  - Dornburg says the finding that individuals are more successful than groups in computer-mediated brainstorming suggests a time- and cost-saving potential for companies. Generally, when electronic group brainstorming is compared to face-to-face brainstorming, it is touted as having the advantages of shorter meetings, increased participation by remote team members, better documentation via electronic recording, and cash savings. But the Sandia research suggests that people working to solve problems on their own might involve less time and, thus less expenses, than electronic group brainstorming.
  - While individuals working alone nominally faired better in this study, Davidson says, the research also indicates that group on-line brainstorming can be effective when ideas are needed from large numbers of people.

- Pakistan’s FATA – A Wicked Problem (local copy), by McMahon, U.S. Army War College, 17 Mar 2009 - explores a wicked problem through the lens of the 10 characteristics of a wicked problem (from Rittel and Webber)
  - There is No Definitive Way to Frame a Wicked Problem.
  - We Cannot Understand a Wicked Problem without Proposing a Solution.
  - Wicked Problems Have No Stopping Rule.
  - Solutions to Wicked Problems are not True-or-False, but Good-or-Bad.
  - There Is No Immediate and No Ultimate Test of a Solution to a Wicked Problem.
  - Every solution to a Wicked Problem is a “One-Shot Operation.”
  - Wicked Problems Do Not Have an Exhaustible Set of Definable Solutions.
  - Every Wicked Problem is Essentially Unique.
  - Every Wicked Problem is a Symptom of Another Problem.
  - The Cause of a Wicked Problem can be Explained in Numerous Ways.

- What Are Wicked Problems? (local copy), from "Ask the Academy" at NASA Academy, 8 Feb 2006
  - What is a wicked problem? Conklin draws his definition from the work of the late urban planner Horst Rittel, who coined the term over thirty years ago:
    1. You don't understand the problem until you have developed a solution.
    2. Wicked problems have no stopping rule. You simply run out of time or money.
    3. Solutions to wicked problems are not right or wrong. They are "better," "worse," "good enough," or "not good enough."

4. Every wicked problem is essentially unique and novel.
5. Every solution to a wicked problem is a "one-shot operation."
6. Wicked problems have no given alternative solutions.

- So where does that leave the project manager? The short answer — what Conklin calls "the Holy Grail of effective collaboration" — lies in "creating shared understanding about the problem, and shared commitment to the possible solutions."

- Defining and Coping with Wicked Problems: the Case of Fort Ord Building Removal (local copy), by Luckey and Schultz, Naval Postgraduate School, Mar 2001

Analysis of Competing Hypotheses Top

- Psychology of Intelligence Analysis (local copy), by Heuer, 1999, for CIA -- very good examination of many elements of critical thinking and mental processes, with examples (PDF version)
  - Chapter 8 - Analysis of Competing Hypotheses

- The Open Source Analysis of Competing Hypotheses Project - A tool made for intelligence analysts. Now free to the public.

- Analysis of Competing Hypotheses from Wikipedia

- more references

Root Cause Analysis Top

- Root Cause Analysis Overview (local copy) - slideshow of the basics, from NASA

- Root Cause Analysis (local copy) - another slideshow of the basics, from NASA

Decision Making and Analysis Top

When you get to the fork in the road, take it.
— Yogi Berra

Short term thinking drives out long term strategy, every time.
— Nobel Prize-winning economist Herbert Simon

- See also cognitive bias

- See also psychological bias

- See also sensemaking

- See also problem solving

- See also critical thinking

- See also intuition

- See also game theory

- See also ethical decision making

- See also media affecting decision making

- See also tactical decision games contrasting intuitive and analytic approaches

- See also John Boyd and the OODA loop

- See also combat leadership, including key historical decisions

- U.S. Army War College
  - Strategic Decision Making Paradigms: A Primer for Senior Leaders (local copy), by Allen and Coates and Woods, U.S. Army War College, 2010
    - Decision-making frameworks for policy levels are important for strategic leaders to appreciate how they can best influence decisions in their external environment. This article's purpose is to present some models or frameworks for understanding how strategic leaders can make decisions as well as recognizing how to influence decisions that affect their organizations or institutions. The following models presented in this article are drawn from the social psychology, organizational behavior, sociology, and public administration literature.
    - Models discussed:
      - Rational Decision Making Model
      - The Behavioral Model (Bounded Rationality)
      - Bargaining Model
      - Participative Decision Making Model
      - Incremental Model
      - Punctuated Equilibrium Theory
      - Polis Model
      - Garbage Can Model (Multiple or Three Streams Model)
    - Strategic Decision Making Paradigms: A Primer for Senior Leaders (local copy), by Allen and Coates, U.S. Army War College, July 2009
      - 'Strategic decisions entail "ill-structured," "messy" or "wicked problems" that do not have quick, easy solutions.'

- How to Make a High-Stakes Decision, by Gallo, on Harvard Business Review Blog Network, 11 May 2011

- 21st Century Small Unit Leaders: Developing the Ultimate Smart Power Weapon (local copy), by Gideons,

paper at Joint Forces Staff College, Joint Advanced Warfighting School (JAWS), 17 June 2011
    - Globalization and the information age have created an environment in which small unit leaders have operational and strategic importance. The demands of the Irregular Warfare require small unit leaders within the General Purpose Forces to be more culturally aware; intellectually adaptable; seasoned in their decision-making requiring fundamental changes in the way they are educated, trained, and gain experience. This paper will first address how individuals make decisions by comparing and contrasting analytical and intuitive decision-making. Second, it will address the strengths and weaknesses in current training and educational paradigms via an analysis of the Systems Approach to Training. Third will be a proposal for the inclusion of new initiatives for developing small unit leader intuition and adaptability in IW. Following this are recommendations for inculcating critical thinking and decision-making skills in small unit leaders by adopting methods of instruction found in Outcomes Based Training and Education and Adaptive Leaders Methodology as well as the experiential based learning that immersive training environments provide.

- Leadership Tunnel Vision (local copy), by Granderson, in *Law Enforcement Bulletin*, Dec 2011

- Maria Konnikova - The Scientific Method of the Mind - an RSA video
    - "Maria Konnikova reveals how Sherlock Holmes can teach us to optimise not only our own everyday existence, but our broader contributions to society and the lives of those around us."

- TED.com videos - most are 6-15 minutes
    - Dan Gilbert: Why we make bad decisions - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Dan Gilbert presents research and data from his exploration of happiness -- sharing some surprising tests and experiments that you can also try on yourself. Watch through to the end for a sparkling Q&A with some familiar TED faces."
    - Tim Harford: Trial, error and the God complex - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Economics writer Tim Harford studies complex systems -- and finds a surprising link among the successful ones: they were built through trial and error. In this sparkling talk from TEDGlobal 2011, he asks us to embrace our randomness and start making better mistakes."
    - Margaret Heffernan: Dare to disagree - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Most people instinctively avoid conflict, but as Margaret Heffernan shows us, good disagreement is central to progress. She illustrates (sometimes counterintuitively) how the best partners aren't echo chambers -- and how great research teams, relationships and businesses allow people to deeply disagree."
        - "The former CEO of five businesses, Margaret Heffernan explores the all-too-human thought patterns -- like conflict avoidance and selective blindness -- that lead managers and organizations astray."
    - Sheena Iyengar on the art of choosing - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Sheena Iyengar studies how we make choices -- and how we feel about the choices we make. At TEDGlobal, she talks about both trivial choices (Coke v. Pepsi) and profound ones, and shares her groundbreaking research that has uncovered some surprising attitudes about our decisions."
    - Kathryn Schulz: On being wrong - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Most of us will do anything to avoid being wrong. But what if we're wrong about that? "Wrongologist" Kathryn Schulz makes a compelling case for not just admitting but embracing our fallibility."
    - Malcolm Gladwell on What we can learn from spaghetti sauce - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Tipping Point author Malcolm Gladwell gets inside the food industry's pursuit of the perfect spaghetti sauce -- and makes a larger argument about the nature of choice and happiness."
    - Noreena Hertz: How to use experts - and when not to - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - We make important decisions every day -- and we often rely on experts to help us decide. But, says economist Noreena Hertz, relying too much on experts can be limiting and even dangerous. She calls for us to start democratizing expertise -- to listen not only to "surgeons and CEOs, but also to shop staff."
    - Barry Schwartz on the paradox of choice - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Psychologist Barry Schwartz takes aim at a central tenet of western societies: freedom of choice. In Schwartz's estimation, choice has made us not freer but more paralyzed, not happier but more dissatisfied."
    - Barry Schwartz: Using our practical wisdom - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "In an intimate talk, Barry Schwartz dives into the question "How do we do the right thing?" With help from collaborator Kenneth Sharpe, he shares stories that illustrate the difference between following the rules and truly choosing wisely."
    - Eric Berlow: How complexity leads to simplicity - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Ecologist Eric Berlow doesn't feel overwhelmed when faced with complex systems. He knows that more information can lead to a better, simpler solution. Illustrating the tips and tricks for breaking down big issues, he distills an overwhelming infographic on U.S. strategy in Afghanistan to a few elementary points."
    - George Whitesides: Toward a science of simplicity - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
        - "Simplicity: We know it when we see it -- but what is it, exactly? In this funny, philosophical talk, George Whitesides chisels out an answer."

        - James Geary, metaphorically speaking - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
            - "Aphorism enthusiast and author James Geary waxes on a fascinating fixture of human language: the metaphor. Friend of scribes from Aristotle to Elvis, metaphor can subtly influence the decisions we make, Geary says."
        - Dan Ariely asks, Are we in control of our own decisions? - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
            - "Behavioral economist Dan Ariely, the author of Predictably Irrational, uses classic visual illusions and his own counterintuitive (and sometimes shocking) research findings to show how we're not as rational as we think when we make decisions."
        - Dan Ariely: Beware conflicts of interest - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
            - "In this short talk, psychologist Dan Ariely tells two personal stories that explore scientific conflict of interest: How the pursuit of knowledge and insight can be affected, consciously or not, by shortsighted personal goals. When we're thinking about the big questions, he reminds us, let's be aware of our all-too-human brains."

    - Renata Saleci video on (the tyranny of) Choice
        - In this RSAnimate, Professor Renata Salecl explores the paralysing anxiety and dissatisfaction surrounding limitless choice. Does the freedom to be the architects of our own lives actually hinder rather than help us? Does our preoccupation with choosing and consuming actually obstruct social change?

    - Jonah Lehrer - The Decisive Moment, video of 30 min. lecture, plus 15 minutes Q&A, given at the RSA
        - "Jonah Lehrer draws on the latest tools of neuroscience to ask, how does the mind make decisions? And how can we make those decisions better?"

    - Improving Analysis: Dealing with Information Processing Errors (local copy), by Rodgers, Warfighter Interface Division, Cognitive Systems Branch, AFRL, Nov 2006
        - Although humans restrict information in a variety of ways, the focus here is on three specific forms that affect human information processing: (a) the tendency to see patterns where none exist, (b) the tendency to seek confirmatory evidence, and (c) the use of preconceived biases.
        - Amos Tversky and Daniel Kahneman presented three heuristics, i.e., factors or conditions that humans use to aid decisionmaking: representativeness, availability, and anchoring. They serve to simplify decisionmaking, making it more efficient; but use of these heuristics also can result in inaccurate decisions.

    - Decision Making -- related theories

    - Good Decisions: Tips and Strategies for Avoiding Psychological Traps (local copy), by Fitch, in the *FBI Law Enforcement Bulletin*, June 2010

    - Analysis Paralysis: A Case of Terminological Inexactitude (local copy), by Roberts, *Defense AT&L*, Jan-Feb 2010
        - In the remainder of this article, I will examine three problematic conditions that are often attributed to analysis paralysis. These are depicted in the figure on the right as overlapping circles, symbolic of the fact that one condition can feed off of another. In the spirit of Churchill, I have also concocted somewhat grandiose but descriptive labels for the three conditions: Analysis Process Paralysis, Risk Uncertainty Paralysis, and Decision Precision Paralysis.

    - Critical Thinking: Plugging (or Moving) a Hole in Our Swiss Cheese (local copy), by Johns, Assistant U.S. Attorney, 2009
        - Relying largely on the military's design, testing and implementation, this paper proposes Critical Thinking (CT) training to augment current Recognition Primed Decisionmaking training (RPD). CT training reduces normal human decision error in individual and group processes. Individual CT can reduce or, in a specific case, close a hole in the Swiss Cheese model. In a group, CT can also move the hole out of alignment. Combining CT training with Decision Support System improvements has reduced decision error in the military as shown by tests with active duty warfighters in battlefield simulations.

    - From Tactical Planning to Operational Design (local copy), by Davison, *Military Review*, Sep-Oct 2008
        - The three military decision-making models reflect a parallel progression in the evolution of systems thinking. Initially, rational military decisionmaking supported solving well-structured problems such as those found in a mechanistic system. Decision-making primed by recognition subsequently evolved to address problems occurring in natural settings with which the decision-maker had experience. An intuitive decision-making process then emerged to cope with those situations for which decision-makers had no previous experience.

    - Recognition-Primed Decision (RPD) Model
        - The Recogition-Primed Decision Model: an Alternative to the MDMP for GWOT (local copy), by Bushey and Forsyth, in *Field Artillery*, Jan-Feb 2006
        - The Recogition-Primed Decision Model (local copy), by Ross et al, in *Military Review*, Jul-Aug 2004
            - "Klein, S. Wolf, Laura G. Militello, and Carolyn E.Zsambok show that skilled decisionmakers usually generate a good COA [course of action] on their first try. J.G. Johnson and M. Raab replicated this finding, extending it to show that when skilled decisionmakers abandon their initial COA in favor of a later one, the subsequent COA's quality is significantly lower than the first one."
        - Decision Making and the Levels of War (local copy), by Killion, in *Military Review*, Nov-Dec 2000
        - Recognition-Primed Decision Strategies: First-Year Interim Report (local copy), by Klein and Crandall, ARI Research Note 90-91, 1990

    - Integrated Planning: The Operations Process, Design, and the Military Decision Making Process (local

copy), by Grigsby et al, *Military Review*, Jan-Feb 2011

- Heuristics and Biases in Military Decision Making (local copy), by Williams, *Military Review*, Sep-Oct 2010
  - The Army values MDMP as the sanctioned approach for solving problems and making decisions. This stolid template is comforting; we are familiar with it. However, what do we do when our enemy does not conform to our assumptions embedded in the process? We discovered early in Iraq that our opponents fought differently than we expected.
  - Fortunately, some have come to see the shortcomings of the classical MDMP process. It is illsuited for the analysis of problems exhibiting high volatility, uncertainty, complexity, and ambiguity. The Army's nascent answer, called "Design," looks promising. As outlined in the new version of FM 5-0, Operations Process, Chapter 3, Design is defined as "a methodology for applying critical and creative thinking to understand, visualize, and describe complex, ill-structured problems and develop approaches to solve them." Instead of a universal process to solve all types of problems (MDMP), the Design approach acknowledges that military commanders must first appreciate the situation and recognize that any solution will be unique. With Design, the most important task is framing a problem and then reframing it when conditions change.
  - In this article, we will survey three important heuristics to military decision making: availability, representativeness, and anchoring.
  - When combining hindsight bias and retrievability biases, we potentially fail to guard against an event popularized euphemistically as a *black swan*.
  - Instead of the usual striving toward a "best practices" methodology, which is also full of potential heuristic biases, reflective practice calls for "valuing the processes that challenge assimilative knowledge (i.e. continuous truth seeking) and by embracing the inevitable conflict associated with truth seeking."

- The Art of Design: a Design Methodology (local copy), by Banach, *Military Review*, Mar-Apr 2009

- Designing Decision Support Systems To Help Avoid Biases & Make Robust Decisions, With Examples From Army Planning, by Chandrasekaran, The Ohio State University, 1 Dec 08 - posted by DTIC

- Battle-Wise: Gaining Advantage in Networked Warfare (local copy), by Gompert et al, Center for Technology and National Security Policy, National Defense University, Jan 2005
- Battle-Wise: Seeking Time-Information Superiority in Networked Warfare (local copy), by Gompert et al, Center for Technology and National Security Policy, National Defense University, July 2006
  - Chapter One - From Firepower to Information Power to Brainpower
  - Chapter Two - Cognitive Demands of Networked Warfare
  - Chapter Four - Defeating Networked Adversaries
  - Chapter Five - Integrating Intuition and Reasoning in Action
  - Chapter Six - From Networking Power to Cognitive Power

- The Reflective Military Practitioner: How Military Professionals Think in Action (local copy), by Paparone and Reed, *Military Review*, Mar-Apr 2008

- Strategic Decision Games: Improving Strategic Intuition (local copy), by DeFoor, Joint Advanced Warfighting School, 23 Apr 2007

- Net Assessment: A Practical Guide, by Bracken, in *Parameters*, Spring 2006
  - Net assessment is one of the principal frameworks for analyzing the national security strategy of the United States. It has been used by the Department of Defense for many years. Understanding net assessment—what it is and what it can do—is important for two reasons. First, it has general application to many military issues. Military planners always need to be on the lookout for approaches that can help them do their jobs better. Net assessment should be in that tool kit.

- Shaping the Next One Hundred Years: New Methods for Quantitative, Long-Term Policy Analysis, by Lempert, Popper, and Bankes; RAND report, 2003
  - A sophisticated reader ought to view with great skepticism the prospect of answering questions about the long-term future. The checkered history of predicting the future — from the famous declarations that humans would never fly to the Limits to Growth study to claims about the "New Economy" — has dissuaded policymakers from considering the effects of their decisions more than a few months or years ahead. However, today's choices will significantly influence the course of the twenty-first century. New analytic methods, enabled by modern computers, may transform our ability to reason systematically about the long term. This report reviews traditional methods of grappling with the morrow, from narratives to scenario analysis, which fail to address the multiplicity of plausible long-term futures. The authors demonstrate a quantitative approach to long-term policy analysis (LTPA). Robust decision methods enable decisionmakers to examine a vast range of plausible futures and design near-term, often adaptive, strategies to be robust across them. Reframing the question "What will the long-term future bring?" as "How can we choose actions today that will be consistent with our long-term interests?" these methods provide powerful analytic support to humans' innate capacity for "what-if-ing."

- Reforming Pentagon Strategic Decisionmaking (local copy), by Lamb and Lachow, INSS, Strategic Forum No. 221, July 2006

- Theory of Effectiveness Measurement (local copy), by Bullock, AFIT dissertation, Sep 2006
  - Effectiveness measures provide decision makers feedback on the impact of deliberate actions and affect critical issues such as allocation of scarce resources, as well as whether to maintain or change existing strategy. Currently, however, there is no formal foundation for formulating effectiveness measures. This research presents a new framework for effectiveness measurement from both a theoretical and practical view. ... Finally, the pragmatic nature of the approach is illustrated by measuring the effectiveness of a notional, security force response strategy in a scenario involving a terrorist attack on a United States Air Force base.

- Cultural Differences
  - Cultural Factors in Complex Decision Making, by Strohschneider, in *Online Readings in Psychology and Culture*, Center for Cross-Cultural Research, Western Washington University, Bellingham, Washington USA, 2002
  - Decision Making in Individualistic and Collectivistic Cultures, by Güss, in *Online Readings in Psychology and Culture*, Center for Cross-Cultural Research, Western Washington University, Bellingham, Washington USA, 2002

- Risk Perception & Strategic Decision Making: General Insights, a New Framework, and Specific Application to Electricity Generation Using Nuclear Energy (local copy), by Brewer, Sandia National Labs, Nov 2005 - some good generic discussion included, such as ten critical thinking processes, with examples for each

- Command Decision-Making: Experience Counts (local copy), by Wolgast, Army War College paper, 2005

- Lee's Mistake: Learning from the Decision to Order Pickett's Charge (local copy), by Gompert and Kugler, *Defense Horizons* number 54, Aug 2006

- Custer in Cyberspace (local copy), by Gompert and Kugler, *Defense Horizons* number 51, Feb 2006
  - One of the consequences of the network revolution and corresponding distribution of authority is that many more persons up and down the ranks will be making combat decisions than compared to the days of centralized command and control. Power is migrating from headquarters "to the edge." Therefore, it is essential to foster battle-wisdom not just for senior officers but also for the junior officers and noncommissioned officers leading units in the field.

- Gladwell, Malcolm. *Blink: The Power of Thinking without Thinking*. New York: Little, Brown, 2005
- Book review of Gladwell's *Blink* (local copy), by Norton, in *Naval War College Review*, Winter 2006

- Future Warfare and the Decline of Human Decisionmaking, by Adams, in *Parameters*, Winter 2001
  - In short, the military systems (including weapons) now on the horizon will be too fast, too small, too numerous, and will create an environment too complex for humans to direct. Furthermore, the proliferation of information-based systems will produce a data overload that will make it difficult or impossible for humans to directly intervene in decisionmaking. This is not a consideration for the remote science-fiction future. Weapons and other military systems already under development will function at increasingly higher levels of complexity and responsibility--and increasingly without meaningful human intervention.

- Cultural Barriers to Multinational C2 Decision Making (local copy), by Klein et al, for 2000 Command and Control Research and Technology Symposium

- Principles for Intelligent Decision Aiding (local copy), by Hutchins, Technical Report 1718, Aug 1996

- Extending Naturalistic Decision Making to Complex Organizations: A Dynamic Model of Situated Cognition, by Shattuck and Miller, Naval Postgraduate School, 2006
  - Naturalistic decision making (NDM) has become established as a methodological and theoretical perspective. It describes how practitioners actually make decisions in complex domains. However, NDM theories tend to focus on the human agents in the system. We extend the NDM perspective to include the technological agents in complex systems and introduce the dynamic model of situated cognition.

- A Literature Review of Analytical and Naturalistic Decision Making (local copy), by Zsambok, Beach, and Klein, for Naval Command, Control and Ocean Surveillance Center, Dec 1992 - examines many decision models/strategies

- Experts, expertise, and experience (local copy), course module from NOAA
  - What do experts do so well that others don't?
    1. Recognize patterns
    2. Detect anomalies
    3. Keep the big picture (situation awareness)
    4. Understand the way things work
    5. Observe opportunities, able to improvise
    6. Relate past, present, and future events
    7. Pick up on very subtle differences
    8. Address their own limitations
  - What is an expert?
    - Novice - Lives in the moment. Can't recognize complex relationships. Produces limited options.
    - Routine Expert - Great at everyday stuff, strong procedural knowledge. Runs into trouble when problems are ill-structured or novel.
    - Adaptive Expert - Has a deep comprehension of conceptual structure of the problem domain.
  - 25 hours of *well done* simulations can achieve the same effect as 2 years of experience (or much more)

- The Future of Simulation Technology for Law Enforcement: Diverse Experience with Realistic Simulated Humans (local copy), by Forsythe, in the *FBI Law Enforcement Bulletin*, Jan 2004

- Automation and Expertise: What is expertise and how can automation work against it? (local copy) briefing by Quoetone, at WDM III Workshop, NOAA (PDF)

- NASA's *ASK* Talks with Dr. Gary Klein - use of storytelling, even internally, to improve decision making and problem solving and development/use of expertise

- The Internet and Congressional Decisionmaking (local copy), a CRS report prepared for the Chairman, House Rules Committee, 19 Sep 2001

- Military Decisionmaking Process (MDMP)
  - Implications of Modern Decision Science for Military Decision-Support Systems, by Davis, Kulick, and Egner, RAND, 2005
  - Military Decision-Making Process (MDMP) (local copy), chapter 5 of FM 101-5 Staff Organization and Operations
  - Is It Time to Abandon the Military Decisionmaking Process (local copy), by McLamb, in *Military Review*, Mar-Apr 2002
  - US Army Decisionmaking: Past, Present, and Future (local copy), by Paparone, in *Military Review*, Jul-Aug 2001
  - How Critical Thinking Shapes the Military Decision Making Process (local copy), by Usry, Naval War College, 2004
    - A lack of Combatant Commander (COCOM) critical thinking in the Military Decision Making Process (MDMP) is a causal factor in military failure at the operational level. However, critical thinking can improve the MDMP of the COCOM. This paper analyzes the effects of critical thinking on the combatant commander's decision making process by: defining critical thinking; illustrating its impact on intuitive and analytical decisions; demonstrating barriers to critical thinking and proposing practical ways to use critical thinking in the MDMP.
- Descriptive Models of Military Decision Making (local copy), by Klein et al, ARI Research Note 90-93, 1990
- Combined Forces Command-Afghanistan Management Decision Model (local copy), DoD IG, July 2005
  - Considering the request for assistance and the proposed application of the MDM, the DoD IG Team created a "universal" model that can be used to assess the capability and capacity of any organization founded on democratic principles and the "Rule of Law." For the purposes of this model, the definition of "organization" includes the full spectrum of organizational structures—from a nation-state to any type of government-, military-, or business-related entity. Consequently, the DoD IG Team built the attached model and identified the high-level elements common to most organizations that should be considered to establish a viable, stable, and selfsustaining institution. This document, therefore, includes the Management Decision Model, instructions on how to use the model, and a comprehensive description of the various elements embedded in the model's architecture.
- Between Discipline and Intuition: the Military Decision Making Process in the Army's Future Force (local copy), a 2004 SAMS paper by Vowell
- Groupthink
  - Hive Mind and Groupthink: the Curse of the Perfect IPT (local copy), by Hewson, in *Defense AT&L*, Nov-Dec 2005
  - Groupthink, Politics, and the Decision to Attempt the Son Tay Rescue, by Amidon, in *Parameters*, Summer 2005
  - Effects of Groupthink on Tactical Decision-Making (local copy), a 2001 SAMS paper by Johnson
  - Groupthink – The Dark Side of Teaming and How To Counteract It! (local copy), by Kaut, TACOM-ARDEC TQM Officer
- New Challenges, New Tools for Defense Decisionmaking , RAND report, 2003
- Foundations for Reasoning in Cognition-Based Computational Representations of Human Decision Making (local copy), by Senglaub et al, Sandia National Laboratories, Nov 2001
- Decision Navigation: Coping with 21st-Century Challenges in Tactical Decisionmaking (local copy), by Gyllensporre, in *Military Review*, Sep-Oct 2003
- Tactical Decision Making (local copy), course by Marine Corps Institute
- Decision Making and Problem Solving (local copy), from Army ROTC
- Evaluation of Cross-Cultural Models for Psychological Operations: Test of a Decision Modeling Approach (local copy, 4 Mb), USAF Research Lab, June 2001
- Expeditionary Air Force Leaders: Cognitive Skills for the Naturalistic Battlespace , by Thomas, Grable, and Stratton, in *Air & Space Power Chronicles* - including discussion of Recognition-Primed Decision-making (RPD)
- SPAWAR Systems Center (SSC), U.S. Navy
  - Decision Support Systems for Coalition Operations: Final Report (local copy), Technical Report 1886, Aug 2002
  - Decision-Making in a Dynamic Environment: The Effects of Experience and Information Uncertainty (local copy), Technical Report 1832, Aug 2000
  - Cognitive Aspects of Decision-Making: Project Summary (local copy), Technical Report 1830, July 2000
  - Cultural Variation in Situation Assessment: Influence of Source Credibility and Rank Status (local copy), Technical Report 1829, July 2000
  - Tactical Decision-Making Under Uncertainty: Experiments I and II (local copy), Technical Report 1821, Apr 2000
  - A Cognitive Model for Exposition of Human Deception and Counterdeception (local copy), Technical Report 1076, Oct 1987
- U. S. Army Research Institute for the Behavioral and Social Sciences - see also ARI critical thinking products
  - Collaboration and Self Assessment: How to Combine 360 Assessments to Increase Self-Understanding (local copy), by Psotka et al, ARI Report, Mar 2007
  - Overview of Practical Thinking Instruction for Battle Command (local copy)
  - Guidelines for Leaders to Consider When Making Decisions (local copy)
  - Making Decisions in Natural Environments (local copy, 5.5 Mb), by Klein, ARI Research, Feb 1997
  - Investigations of Naturalistic Decision Making and the Recognition-Primed Decision Model (local copy), by Klein and Calderwood, ARI Research Note 96-43

        - The Development of Knowledge Elicitation Methods for Capturing Military Expertise (local copy), by Klein, ARI Research Note 96-14
        - Predicting Rapid Decision-Making Processes Required by the Dismounted Objective Force Warrior (local copy, .7 Mb)
        - Emotional Synthetic Forces (local copy)
            - The objective of this research was to make the decision-making process of complex agents less predictable and more realistic, by incorporating emotional factors that affect humans.
        - Measures of Platoon Leader Situation Awareness in Virtual Decision-Making Exercises (local copy)
        - Assessing decision-making skills in virtual environments (local copy, 2.42 Mb)
        - Decision-Centered MOUT Training for Small Unit Leaders (local copy, 2.08 Mb)
        - Evaluating an Approach to MOUT Decision Skills Training (local copy, 1.66 Mb)
        - Training Future Force Leaders to Make Decisions Using Digital Information (local copy, 2.3 Mb), Dec 2003, ARI report
            - "... digital information such as video sensors and detailed map overlays will replace probabilistic cues from the environment."
            - "While the decisions themselves do not differ, the decision-making process and the information used are different with digital information than with traditional cues. Decision making with digital information is more analytical ...."
            - "Spatial orientation will become a key issue and skill in the electronic battlefield."

- The Case for a Joint Military Decisionmaking Process (local copy), by Anderson and Slate, in *Military Review*, Sep-Oct 2003
- Developing the Capacity for Decisive Action (local copy), by Krawchuk, in *Military Review*, Nov-Dec 2000 - 2000 MacArthur Writing Award 1st Place

- Decision Making and Problem Solving (local copy), self-study course from FEMA
- Decision Making in a Crisis (local copy), self-study course from FEMA

- Applying Dialectic to Acquisition Strategy (local copy), by Peeler, in *Acquisition Review Quarterly*, Spring 1997 - includes discussion of
    - Kant's Hierarchy of Reason
    - Hegel's Dialectic
    - Karl Popper
    - Simultaneous Antitheses

- General Robert E. Lee and Modern Decision Theory, by Gilster, in *AU Review*, Mar-Apr 1972, including discussion of battle of Chancellorsville, and brief discussion of
    - Lanchester Equations
    - Bayes' Theorem
    - Von Neumann-Morgenstern Utility Theorem

- NATO's Decision-Making Procedure (local copy), CRS report
- NATO Decisionmaking: Au Revoir to the Consensus Rule? (local copy), by Michel, Strategic Forum 202, Aug 2003

- The Ecology of Uncertainty: Sources, Indicators, and Strategies for Informational Uncertainty (local copy), by Schunn et al, Naval Research Lab

- The Center for Decision Research, U. of Chicago - including downloadable articles/papers

- Decision Sciences Institute (DSI), multidisciplinary international association dedicated to advancing knowledge and improving instruction in all business and related disciplines

- DoD Information Analysis Centers (IACs)

- Effective decision-making processes for the Joint Force Commander (local copy), from the *Air Land Sea Bulletin*, at the Air Land Sea Application Center

- Are You a Good Decision Maker? (local copy), from SBA -- includes "Ten Steps to Wise Decision-Making" and "Common Decision-Making Mistakes"

- The Human Side of Decision Making (local copy), from FAA -- brief examination of the human traits that interfere with decision-making

- Ladder of Inference (local copy), from NIH - "a model that describes an individual's mental process of observing situations, drawing conclusions and taking action"

- Intuitive Policing - Emotional/Rational Decision Making in Law Enforcement (local copy), by Pinizzotto et al, in the *FBI Law Enforcement Bulletin*, February 2004

- Making Ethical Decisions - A Practical Model (local copy), by Schafer, in the *FBI Law Enforcement Bulletin*, May 2002

- Cultivating Intuitive Decisionmaking (local copy), by Krulak, in *Marine Corps Gazette*, May 1999, as posted on the USMC Commandant's Page

- War in the Pits: Marine-Futures Traders Wargame (local copy), NDU Strategic Forum 61, by West
    - Marine generals and colonels vs futures traders in decisionmaking wargame
    - "The traders' OODA loop, executed at much higher speed, is ISAA: Information, Sort by Priority, Act, Assess"
- Virtual Stress (local copy), in *Marines Online*, senior Marines vs futures traders in decision making wargame

- The Collapse of Decisionmaking and Organizational Structure on Storm King Mountain (local copy), by

Putnam, USDA Forest Service, 1995
    - Numerous studies show no matter how many factors are important, the human mind normally can handle only about seven factors (e.g., seven-digit telephone numbers).
    - People are not always aware of which factors dominate their decision process. Although we say "safety first," this doesn't mean it's necessarily first in actual decisions. Also, people are seldom aware of the few factors they actually are processing so tend to be overconfident in their decisionmaking ability.
    - Studies also show that our linear thinking tends to underestimate hazards, particularly if the hazard is increasing at a logarithmic or exponential rate as can happen on the fireline. An example would be estimating rates of fire spread. A computer would give the better decision in a heartbeat. People would tend to underestimate the rate of spread and have difficulty deciding on an appropriate course of action. And so it is important to understand the limits of how we process information and common types of errors that can occur.

- Eliciting Knowledge from Experts: A Methodological Analysis, by Hoffman et al, NASA Human-Factors workshop paper

- Revisiting the Abilene Paradox - Is Management of Agreement Still an Issue?, by Deiss - brief discussion of the mismanagement of agreement, where nobody in a group wants to do an activity, but the group does it because each member thinks all the others want to do it

- Strategic Leadership and Decision Making (local copy), book from NDU

- Intuition: an Imperative of Command (local copy), by Rogers, in *Military Review* - examines relevance of intuition to decision making in the context of warfighting on the modern battlefield

- Decisionmaking Theory (local copy), Marine Corps Doctrine Publication 6
    - "the intuitive approach is more appropriate for the vast majority of typical tactical or operational decisions-decisions made in the fluid, rapidly changing conditions of war when time and uncertainty are critical factors, and creativity is a desirable trait"

    - Note 18. Intuitive decisionmaking more appropriate for the vast majority of tactical/operational decisions: A 1989 study by Gary A. Klein (based on 1985 observations) estimated that decision makers in a variety of disciplines use intuitive methods 87 percent of the time and analytical methods 13 percent of the time. Evidence now suggests that this study was actually biased *in favor of analysis*. More recent studies estimate the breakdown at more nearly 95 percent intuitive to 5 percent analytical. G. A. Klein, "Recognition-Primed Decisions" in William B. Rouse (ed.), *Advances in Man-Machine System Research* (Greenwich, CT: Jai Press, 1989); G. L. Kaempf, S. Wolf, M. L. Thordsen, and G. Klein, *Decision Making in the Aegis Combat Information Center* (Fairborn, OH: Klein Associates, 1992); R. Pascual and S. Henderson, "Evidence of Naturalistic Decision Making in Command and Control" in C. Zsambok and G. Klein (eds.), *Naturalistic Decision Making*, forthcoming publication (Hillsdale, NJ: Lawrence Erlbaum Associates); Kathleen Louise Mosier, *Decision Making in the Air Transport Flight Deck: Process and Product*, unpublished dissertation (Berkeley, CA: University of California, 1990).

- Decision Making Theory (local copy), Naval Doctrine Publication 6, Naval Command and Control
    - "The intuitive approach is clearly more appropriate for the fluid, rapidly changing environment of combat, when time and uncertainty are critical factors."

- Strategic Decisionmaking in the Information Age, Army War College Strategic Leadership Workshop (local copy)
    - Rational Decision-Making Model
    - Ogilvie's Action Based (Naturalistic)Model
    - Klein's Recognition-Primed Decision-Making Model
    - Logical Incrementalism

- Naturalistic Decision Making (local copy), "an attempt to understand how humans actually make decisions in complex real-world settings," by Klein and Klinger, 4 pages, in Human Systems IAC *Gateway*, vol XI, nbr 3 -- article contrasts naturalistic with recognition-primed decision (RPD) model

- Strategies of Decision Making (local copy), by Klein, in *Military Review*, May 1989

- Executive Decision Making (local copy, including bite-size pieces for faster loading), handbook from the Naval War College
- Case Studies in Policy Making and Implementation (local copy, including bite-size pieces for faster loading) - handbook from the Naval War College
- Syllabus for National Security Decision Making, Naval War College

- A Framework for Military Decision Making under Risks (abstract) (full copy), by Schultz, School of Advanced Airpower Studies (SAAS) - includes discussion of Eisenhower's decision regarding Operation Market Garden - see especially Chapter 2, Military Decision Making and Prospect Theory -

- **Risk-Based Decision Making (RBDM)**, U.S. Coast Guard Research & Development Center, Groton, CT
    - Quick-reference Guide to Risk-based Decision Making (local copy), by Macesker
    - Building a Toolbox for Risk-based Decision Making Within Your Organization (local copy), by Macesker and Dolph
    - Why RBDM? (local copy)
    - RBDM - Where Do I Start? (local copy)
    - RBDM - Ten Common Risk Questions Answered (local copy)
    - RBDM - How Were Tools Chosen? (local copy)
    - RBDM - Data Compendium (local copy)

- Applying Risk-based Decision-making Methods/Tools to U.S. Navy Antiterrorism Capabilities (local copy), by

Mitchell and Decker, at Homeland Security Symposium and Exposition, 27 May 2004

- Decision Making and the Availability Heuristic - a self test of how publicity affects your reasoning

- Problem Solving and Decision Making: Consideration of Individual Differences - Using the Myers-Briggs Type Indicator (MBTI), by Huitt

- Command Decisions, collection of essays on the key decisions by both sides in both theaters of WW II

- Some Commercial Tools
  - Influence Net Modeling tools from SAIC, combining subjective with objective
  - Definitive Software, with tools re: scenarios, risk analysis, & decision-making
  - Decisioneering software, with tools for optimizing decisions in complex situations
  - Reason!Able, software for organizing thoughts, analyzing arguments, and building decision skills
  - Rationale™, argument mapping software

- Techniques for Effective Decision Making, at Mind Tools

- Decision-Making, by Kent, in *AU Review*, May-June 1971 - addressing the problems and use of analysis
- More On Decision-Making, by Blythe, in *AU Review*, Jan-Feb 1972 - follow-on and response to above article

- **Organizations**
- Decision Analysis Society

- European Association for Decision Making (EADM)
- Society for Judgment and Decision Making
- Society for Risk Analysis
- Center for the Decision Sciences, Columbia University

- **Institutes and Schools**
- Decision Consortium, U. of Mich.
- Josephson Institute of Ethics
  - The Seven-Step Path to Better Decisions - expanded description of steps below
    1. Stop and Think
    2. Clarify Goals
    3. Determine Facts
    4. Develop Options
    5. Consider Consequences
    6. Choose
    7. Monitor and Modify

- **Journals**
- Organizational Behavior and Human Decision Processes, journal
- Journal of Behavioral Decision Making
- Journal of Risk and Uncertainty

- **Medical Decision Making**
- Society for Medical Decision Making (SMDM)
- Medical Decision Making journal
- Clinical Decision Making, MIT

- **Gaming and Decision Theory**
- Coevolution: Studying the Dynamics of Competition, and Gauss: Scenario Translation (local copy), by McDonald, of SAIC, at Project Albert International Workshop 5, posted by USMC Warfighting Lab - includes out-thinking, out-doing, reflexive control, OODA loop, recursive anticipation, co-adaptation, adaptive mental model, and more

- Game Theory.net, "a resource for educators and students of game theory"
- Stability Modeling and Game-Theoretic Considerations, Los Alamos National Labs (local copy)
- Decision-Theory for Crisis Management, Final Report, ARPA (local copy)
- A Framework for Military Decision Making under Risks (abstract) (full copy), by Schultz, School of Advanced Airpower Studies (SAAS) -- see especially Chapter 2, Military Decision Making and Prospect Theory

- A Complex Adaptive System (CAS) Approach to Public Policy Decision Making, by Eoyang, Yellowthunder, and Ward
- Using Decision Procedures to Accelerate Domain-Specific Deductive Synthesis Systems (local copy), by Baalen and Roach, NASA
- Tools for Decision Analysis: Analysis of Risky Decisions, probabilistic modeling, by Arsham, U. of Baltimore

- Methods for Eliciting Strategic Knowledge (Tables) (local copy), prepared for NATO Defense Group

Paradox of Choice Top

- Sheena Iyengar on the art of choosing - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "Sheena Iyengar studies how we make choices -- and how we feel about the choices we make. At TEDGlobal, she talks about both trivial choices (Coke v. Pepsi) and profound ones, and shares her groundbreaking research that has uncovered some surprising attitudes about our decisions."

- Barry Schwartz on the paradox of choice - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "Psychologist Barry Schwartz takes aim at a central tenet of western societies: freedom of choice. In Schwartz's estimation, choice has made us not freer but more paralyzed, not happier but more dissatisfied."

- Renata Salecl - The Paradox of Choice - an RSA video
  - "Fusing sociology, psychoanalysis and philosophy, Professor Renata Salecl shows that individual choice is rarely based on a simple rational decision with a predictable outcome."

- Baba Shiv: Sometimes it's good to give up the driver's seat - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "Over the years, research has shown a counterintuitive fact about human nature: That sometimes, having too much choice makes us less happy. This may even be true when it comes to medical treatment. Baba Shiv shares a fascinating study that measures why choice opens the door to doubt, and suggests that ceding control -- especially on life-or-death decisions -- may be the best thing for us."

Assumption-Based Planning Top

- The Importance of "Wild Card" Scenarios (local copy), by Dewar, for National Intelligence Council NIC 2020 project

- Assumption-Based Planning: A Planning Tool for Very Uncertain Times, by Dewar, Builder, Hix, and Levin, a RAND Monograph Report,

- other RAND reports concerning Assumption-Based Planning

- Assumption-Based Planning: a Tool for Reducing Avoidable Surprises, by Dewar, a RAND report, printed by Cambridge University Press

Game Theory Top

- See also game theory at Cyberspace and Information Operations Study Center

- Game Theory .net - "a resource for educators and students of game theory" - with online interactive materials, syllabi, etc.

- Game Theory category at Wikipedia

- Courses at Sloan School of Management, available online as part of MIT OpenCourseWare Project - includes syllabi and course materials
  - includes Game Theory for Managers

- Game Theory, from the Stanford Encyclopedia of Philosophy

- The Compleat Strategyst: Being a Primer on the Theory of Games of Strategy, by Williams, RAND - classic book from 1954

Uncertainty & Risk Top

- Journal of Risk and Uncertainty

- Risk intelligence: How to live with uncertainty, RSA video by Evans
  - Risk intelligence expert Dylan Evans outlines a powerful form of thinking; one where the same intuition seen in the best poker players can be effectively transferred to business, politics and everyday life.

- Daniel Kahneman: The riddle of experience vs. memory - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "Using examples from vacations to colonoscopies, Nobel laureate and founder of behavioral economics Daniel Kahneman reveals how our "experiencing selves" and our "remembering selves" perceive happiness differently. This new insight has profound implications for economics, public policy -- and our own self-awareness."
  - "Widely regarded as the world's most influential living psychologist, Daniel Kahneman won the Nobel in Economics for his pioneering work in behavioral economics -- exploring the irrational ways we make decisions about risk."

- The Ecology of Uncertainty: Sources, Indicators, and Strategies for Informational Uncertainty (local copy), by Schunn et al, Naval Research Lab

- Decisionmaking Theory (local copy), Marine Corps Doctrine Publication 6
  - "the intuitive approach is more appropriate for the vast majority of typical tactical or operational decisions-decisions made in the fluid, rapidly changing conditions of war when time and uncertainty are critical factors, and creativity is a desirable trait"

- Certain Uncertainty: Inoculating for Surprise, by Beaumont, in *Air University Review*

- Risk Perception & Strategic Decision Making: General Insights, a New Framework, and Specific Application to Electricity Generation Using Nuclear Energy (local copy), by Brewer, Sandia National Labs, Nov 2005 - some good generic discussion included, such as ten critical thinking processes, with examples for each

- Improving CIA Analytic Performance: Strategic Warning (local copy), by Davis, occasional paper for CIA's Improving CIA Analytic Performance: Strategic Warning - includes discussion of "Substantive Uncertainty and Strategic Warning" and "Analytic Tradecraft for Managing Substantive Uncertainty" and "Averting Strategic Surprise through Alternative Analysis"

- Expecting the Unexpected (local copy), by Frasqueri-Molina, in NASA's *ASK* magazine, issue 43, Summer 2011 - creating a mitigation plan to deal with unexpected risks
  - The author developed a risk-mitigation plan to reestablish order from chaos.
    1. Remain calm.
    2. Halt the entire project or just the affected work momentarily and let everyone take a break.

3. Immediately gather the resolution team, which consists of the project manager and any of the people who can offer solutions; meet privately.
4. Assess risk impact.
5. Brainstorm solutions.
6. Choose a solution.
7. Obtain project sponsor approval.
8. Communicate the solution to the entire team, resume project, resolve risk.

- A Framework for Military Decision Making under Risks (abstract) (full copy), by Schultz, School of Advanced Airpower Studies (SAAS) - includes discussion of Eisenhower's decision regarding Operation Market Garden - see especially Chapter 2, Military Decision Making and Prospect Theory -

- **Risk-Based Decision Making (RBDM)**, U.S. Coast Guard Research & Development Center, Groton, CT
  - Quick-reference Guide to Risk-based Decision Making (local copy), by Macesker
  - Building a Toolbox for Risk-based Decision Making Within Your Organization (local copy), by Macesker and Dolph
  - Why RBDM? (local copy)
  - RBDM - Where Do I Start? (local copy)
  - RBDM - Ten Common Risk Questions Answered (local copy)
  - RBDM - How Were Tools Chosen? (local copy)
  - RBDM - Data Compendium (local copy)

- Applying Risk-based Decision-making Methods/Tools to U.S. Navy Antiterrorism Capabilities (local copy), by Mitchell and Decker, at Homeland Security Symposium and Exposition, 27 May 2004

Complex vs. Complicated Top

- Eric Berlow: Simplifying complexity - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "Ecologist Eric Berlow doesn't feel overwhelmed when faced with complex systems. He knows that more information can lead to a better, simpler solution. Illustrating the tips and tricks for breaking down big issues, he distills an overwhelming infographic on U.S. strategy in Afghanistan to a few elementary points."

- Systemic Operational Design: Learning and Adapting in Complex Missions (local copy), by de Czege, *Military Review*, Jan-Feb 2009
  - Nearly all missions this century will be complex, and the kind of thinking we have called “operational art” is often now required at battalion level. Fundamentally, operational art requires balancing design and planning while remaining open to learning and adapting quickly to change. Design is not a new idea. Command has always entailed responsibility for designing operations while penetrating complexity and framing problems that planners have to solve. Individual ability to learn effectively, adapt rapidly and appropriately, and to solve problems has always been self-evidently valuable to commanders. Yet, collectively, a command’s overall quality of design, learning, and adaptation is what determines results. Military leaders may value individual creativity, critical thinking, continuous learning, and adaptability in their staffs and subordinate commanders, but individual traits do not necessarily add up to collective abilities needed for the best outcomes.

  - **Complicated versus complex systems.** Merely complicated systems are composed of numerous parts and structures, all logically separable from their environment. An example would be the system for deploying units on a time table for an operation like D-day. Such a schedule could be accurately analyzed in the abstract. Complex systems are made up of dynamic, interactive, and adaptive elements that cannot be separated from interaction with their environments. The significant elements of complex systems are human beings and their relationships. An example would be the action-reaction interplay of the various actors in cooperation and contention on D-day. Analysis could never predict the relationships that were the most important part of the flow of events.

    Where merely complicated systems require mostly deduction and analysis (formal logic of breaking into parts), complexity requires inductive and abductive reasoning for diagnostics and synthesis (the informal logic of making new wholes of parts). Because the elements of complex systems we care most about are human ones, making sense of relationships requires hypothetical synthesis in the form of maps or narratives. Such maps and narratives evolve as informal products that reflect a dimly perceived truth at a moment of understanding in time. To make the best sense of human relationships, interactions, trends, and propensities, military commands have to adopt a habitually skeptical approach to such non-deductive conclusions. Such habituation implies a new intellectual culture that balances design and planning while evincing an appreciation for the dynamic flow of human factors and a bias toward perpetual learning and adapting.

- Adding to the Toolkit: Three Conceptual Tradeoffs (local copy), by Austin, SAMS paper, AY10
  - This monograph shows how understanding three conceptual tradeoffs of complex versus complicated, complexity at large-scale versus fine-scale, and exploration of potential problems versus exploitation of known solutions can help the military practitioner better learn, anticipate and adapt to difficult problems. It does so by defining the three conceptual tradeoffs and then applying them to Operation Iraqi Freedom for the United States in 2003 and the Israeli incursion into Southern Lebanon by the Israeli Defense Forces in 2006. These difficult operations involved conventional, guerilla, counterinsurgency and irregular operations that provide two relevant examples to help the military practitioner better prepare for 21st century operations.

  - Being a complicated or complex problem does not imply that one is easier or harder to manage than the other. They are just different. Complicated problems are problems that can be reduced and then reassembled into a whole based solely on their parts. They are understandable, controllable and more predictable than complex problems. Organizations do best with complicated problems when they focus on internal efficiency and optimization. Complex problems are not as predictable due to interdependencies and feedback. Organizations that learn, evolve, and adapt with distributed

command and control manage them best. Although the ends may be the same, the ways and means to solve complex versus complicated problems are different.

- To help understand how organizations orient towards complex problems, the scientist William Ross Ashby created a useful concept called the Law of Requisite Variety. It states that a problem can only be controlled if the variety of the controller matches the variety of the situation to be controlled. Put another way, the complexity of a task must be matched by the complexity of a system trying to perform the task effectively.

- Much as hierarchically controlled organizations are able to focus on efficiency and optimization, the more distributed the command and control of an organization, the less efficient it becomes, despite its potential ability to manage more complexity. Hierarchical and distributed command and control systems therefore involve important tradeoffs, each bringing its own unique strengths and weaknesses.

Complex Systems Top

- See Chaos & Complexity on Theory page

- TED videos
  - Eric Berlow: Simplifying complexity - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
    - "Ecologist Eric Berlow doesn't feel overwhelmed when faced with complex systems. He knows that more information can lead to a better, simpler solution. Illustrating the tips and tricks for breaking down big issues, he distills an overwhelming infographic on U.S. strategy in Afghanistan to a few elementary points."
  - George Whitesides: Toward a science of simplicity - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
    - "Simplicity: We know it when we see it -- but what is it, exactly? In this funny, philosophical talk, George Whitesides chisels out an answer."
  - Tim Harford: Trial, error and the God complex - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
    - "Economics writer Tim Harford studies complex systems -- and finds a surprising link among the successful ones: they were built through trial and error. In this sparkling talk from TEDGlobal 2011, he asks us to embrace our randomness and start making better mistakes."

- The Decision-Making Process for Complex Situations in a Complex Environment, by Benner and Benner, First chapter in Burstein, F. and Holsapple, C.W. (Eds). Handbook on Decision Support Systems. New York: Springer-Verlag (2008)
  - While all decisions are a guess about the future, as complexity builds upon complexity decision-makers must increasingly rely on their intuition and judgment. This chapter explores the decision-making process for complex situations in a complex environment (complex adaptive messes) in terms of: laying the groundwork for decision-making, understanding and exploring complex situations, discussing human additive factors, preparing for the decision process and mechanisms for influencing complex situations. Laying the groundwork introduces the concepts of emergence, the butterfly effect, the tipping point, feedback loops and power laws. Mechanisms for influencing complex situations include structural adaptation, boundary management, absorption, optimum complexity, simplification, sense and respond, amplification, and seeding. The authors forward that decision-makers may be able to construct a strategy that guides problem resolution through a sequence of decisions and actions leading toward an acceptable solution.

- Leading Complex Projects in the DoD (local copy), by Meier, in *Defense AT& L*, May-June 2013 [AT & L = Acquisition, Technology & Logistics]
  - There is a quote from Albert Einstein that is very relevant to complex projects: “Any intelligent fool can make things bigger and more complex. ... It takes a touch of genius—and a lot of courage—to move in the opposite direction.” In many cases, it is organizations, agencies, and senior committees that make projects bigger and more complex than they need to be. My hope is that this article will provide leaders of complex projects with the data and the courage to reduce complexity and deliver complex projects within scope, cost, and schedule.

- Leadership and Systems Thinking (local copy), by Reed, in *Defense AT& L*, May-June 2006 [AT & L = Acquisition, Technology & Logistics]
  - The Department of Defense is a large and complex social system with many interrelated parts. As with any system of this type, when changes are made to one part, many others are affected in a cascading and often unpredictable manner. Thus, organizational decisions are fraught with second- and third-order effects that result in unintended consequences. “Fire and forget” approaches are rarely sufficient and are sometimes downright harmful.
  - Peter Senge submits, in *The Fifth Discipline*, that systems thinking provides just the type of discipline and toolset needed to encourage the seeing of “interrelationships rather than things, for seeing patterns of change rather than static ‘snapshots.’” Senge argues that this shift of mind is necessary to deal with the complexities of dynamic social systems.

- Complexity, Conflict Resolution, and How the Mind Works, by Jones and Hughes, in *Conflict Resolution Quarterly*, Summer 2003

- New England Complex Systems Institute (NECSI)
  - "Significant points" in the study of complex systems, by Yaneer Bar-Yam
  - Visualizing Complex Systems Science (CSS), ongoing NECSI project

- MIT Center for Collective Intelligence (CCI)
  - MIT Center for Coordination Science (CCS) was reorganized and renamed in June 2006 to be CCI

- MIT Computer Science and Artificial Intelligence Lab (CSAIL)

- Overcoming the 90% Syndrome: Iteration Management in Concurrent Development Projects, by Sterman

Abductive, Deductive, and Inductive Reasoning Top

- See critical thinking above
- See Holmes' comments above
- Peirce, Pragmatism, and The Right Way of Thinking (local copy), by Campbell, Sandia National Labs, Aug 2011
  - Peirce is known as the founder of the philosophy of pragmatism and these lectures, given near the end of his life, represent his mature thoughts on the philosophy. Peirce's decomposition of thinking into abduction, deduction, and induction is among the important points in the lectures.
- Adaptive Peircean Decision Aid Project Summary Assessments (local copy), by Senglaub, Sandia National Laboratories, Dec 2006
  - Abstract - This effort's objective was to identify and hybridize a suite of technologies enabling the development of predictive decision aids for use principally in combat environments but also in any complex information terrain. The technologies required included formal concept analysis for knowledge representation and information operations, Peircean reasoning to support hypothesis generation, Mill's canons to begin defining information operators that support the first two technologies and co-evolutionary game theory to provide the environment / domain to assess predictions from the reasoning engines. The intended application domain is the IED problem because of its inherent evolutionary nature. While a fully functioning integrated algorithm was not achieved the hybridization and demonstration of the technologies was accomplished and demonstration of utility provided for a number of ancillary queries.
  - Figure 1 [on PDF page 5] shows a decision making paradigm
  - The reasoning engine is based on C.S. Peirce's model of scientific inquiry. This philosophical construct provides the foundation for how we as humans reason about situations new to us. This model consists of three reasoning capabilities; Abduction, deduction and induction. A crude way of looking at this suite of logic is abduction provides plausible hypotheses to explain an observation, deduction provides a basis for selecting from that set of hypotheses, and induction is the means to validate the hypothesis selected.
- Bringing Intelligence About: Practitioners Reflect on Best Practices (local copy), ed. by Swenson, Joint Military Intelligence College, 2003
  - Reasoning: The ability to reason is what permits humans to process information and formulate explanations, to assign meaning to observed phenomena. It is by reasoning that analysts transform information into intelligence, in these three ways:
    - 1. Induction: Inductive reasoning combines separate fragments of information, or specific answers to problems, to form general rules or conclusions. For example, using induction, a child learns to associate the color red with heat and heat with pain, and then to generalize these associations to new situations. Rigorous induction depends upon demonstrating the validity of causal relationships between observed phenomena, not merely associating them with each other.
    - 2. Deduction: Deductive reasoning applies general rules to specific problems to arrive at conclusions. Analysts begin with a set of rules and use them as a basis for interpreting information. For example, an analyst who follows the nuclear weapons program of a country might notice that a characteristic series of events preceded the last nuclear weapons test. Upon seeing evidence that those same events are occurring again, the analyst might deduce that a second nuclear test is imminent. However, this conclusion would be made cautiously, since deduction works best in closed systems such as mathematics, making it of limited use in forecasting human behavior.
    - 3. Abduction: Abductive reasoning describes the thought process that accompanies "insight" or intuition. When the information does not match that expected, the analyst asks "why?," thereby generating novel hypotheses to explain given evidence that does not readily suggest a familiar explanation. For example, given two shipping manifests, one showing oranges and lemons being shipped from Venezuela to Florida, and the other showing carnations being shipped from Delaware to Colombia, abductive reasoning is what enables the analyst to take an analytic leap and ask, "Why is citrus fruit being sent to the worldwide capital of citrus farming, while carnations are being sent to the world's primary exporter of that product? What is really going on here?" Thus, abduction relies on the analyst's preparation and experience to suggest possible explanations that must then be tested. Abduction generates new research questions rather than solutions
- Essays and Arguments: A Handbook on Writing Argumentative and Interpretative Essays, by Johnston, May 2000, in public domain
  - Section Five, Deduction and Induction
- Manual of Job-Related Thinking Skills (local copy), Department of Homeland Security - including deductive reasoning, reasoning with sets, inductive reasoning about real-world events, and statistical reasoning - includes quizzes throughout
- Statistics and Trace Evidence: The Tyranny of Numbers (local copy), by Houck, in *Forensic Science Communications*, FBI - discusses induction and deduction and their application in establishing evidence - see especially the section "How Do We Know All Ravens Are Black?"
- quick definitions at an NIH site listing desired job skills
  - Deductive Reasoning - Able to apply general rules to specific problems to come up with logical answers, including deciding whether an answer makes sense.
  - Inductive Reasoning - Able to combine separate pieces of information, or specific answers to problems, to form general rules or conclusions. This includes coming up with a logical explanation for

why seemingly unrelated events occur together.

- Janusian Thinking and Acting (local copy), by Paparone and Crupi, in *Military Review*, Jan-Feb 2002
  - The authors maintain that the current U.S. approach to military operations-strategic, operational, and tactical-is too linear for today's contemporary operating environment. They argue that future warfighters must move beyond linear thought and action to a realm of thinking and acting that recognizes and accepts paired yet opposite ideas and actions
  - "Instead of ruling out alternative hypotheses, Janusian thinking calls on us to embrace contradictions as naturally occurring phenomena. When we create insights for thinking and acting from the Janusian framework, we achieve remarkable explanatory power over the nature of human information processing."

- The seats of reason? An imaging study of deductive and inductive reasoning, by Goel et al, Dept of Psychology, York U., North York, Ontario, CA -- abstract posted by National Library of Medicine

  We carried out a neuroimaging study to test the neurophysiological predictions made by different cognitive models of reasoning. Ten normal volunteers performed deductive and inductive reasoning tasks while their regional cerebral blood flow pattern was recorded using [15O]H2O PET imaging. In the control condition subjects semantically comprehended sets of three sentences. In the deductive reasoning condition subjects determined whether the third sentence was entailed by the first two sentences. In the inductive reasoning condition subjects reported whether the third sentence was plausible given the first two sentences. The deduction condition resulted in activation of the left inferior frontal gyrus (Brodmann areas 45, 47). The induction condition resulted in activation of a large area comprised of the left medial frontal gyrus, the left cingulate gyrus, and the left superior frontal gyrus (Brodmann areas 8, 9, 24, 32). Induction was distinguished from deduction by the involvement of the medial aspect of the left superior frontal gyrus (Brodmann areas 8, 9). These results are consistent with cognitive models of reasoning that postulate different mechanisms for inductive and deductive reasoning and view deduction as a formal rule-based process.
  PMID: 9175134 [PubMed - indexed for MEDLINE]

- Deductive Logic, by St. George Stock, posted by Project Gutenberg

Counterfactual Reasoning Top

- Counterfactual Reasoning: A Basic Guide for Analysts, Strategists, and Decision Makers (local copy), by Hendrickson, *The Proteus Monograph Series*, Oct 2008
  - Counterfactual reasoning is the process of evaluating conditional claims about alternate possibilities and their consequences (i.e., “What If” statements). These alternatives can be either past possibilities (e.g., “If the United States had not abolished the Iraqi army in 2003, then the Iraqi insurgency would have been significantly smaller in 2005”) or future possibilities (e.g., “If Iran had nuclear weapons, then it would provide this technology to Hezbollah”). Counterfactuals are essential to intelligence analysis because they are implicit in all strategic assessments.
  - Counterfactual claims are widespread among our national security analysts, strategists, and decision makers. Unfortunately, this is not widely recognized. Furthermore, there is no comprehensive model of counterfactual reasoning to which anyone may turn if they do become aware of the ubiquitous nature of counterfactuals within intelligence and national security. Instead, there are several fragmented approaches in philosophy, logic, history, political science, and psychology. To make matters worse, none of these approaches has been applied to the unique challenges of intelligence and security. In response, this work seeks to demonstrate both the structure and the significance of counterfactual reasoning. It offers not only the first complete system of counterfactual reasoning (of which this author is aware), but the first one specifically designed to address the domain of intelligence analysis and national security. Furthermore, this work proposes three major claims about the place of counterfactual reasoning in analysis and strategy. Therefore, this work is not only intended to serve as an *education* in counterfactual reasoning, but also as an *exhortation* to counterfactual reasoning.
  - **First Major Proposal** (The Strategic Presumption of Counterfactuals): All strategies (and analyses of them) are grounded in a series of counterfactual claims about alternate possibilities, their consequences, and the relationships between them.
  - **Second Major Proposal** (The Systematic Potential of Counterfactuals): Major extant methods for assessing alternate possibilities, their consequences, and the relationships between them may be viewed as ultimately not distinct, but as aspects of a single process—counterfactual reasoning.
  - **Third Major Proposal** (The Structural Priority of Counterfactuals): All assessment of alternate possibilities, their consequences, and the relationships between them should ultimately be conditional (as it is in counterfactual reasoning).

Dialectical Reasoning Top

- The Dialectical Dimension of the Moral Military Decision Making - an Idealistic Approach, by Stadler, for JSCOPE 2000 Conference

- Dialectical Versus Empirical Thinking: Ten Key Elements of the Russian Understanding of Information Operations (local copy), by Thomas, CALL Publication 98-21

- The Links between Science, Philosophy, and Military Theory: Understanding the Past, Implications for the Future , by Pellegrini, for SAAS

- The effect of cultural differences in fear of isolation on dialectical reasoning, by Kim and Markman, U. of TX

Fast and Slow Thinking Top

- See also intuition

- Dual process theory, Wikipedia article

- *Thinking, Fast and Slow*, by Kahneman, 2011
  - Book review of *Thinking, Fast and Slow*, by Kahneman (local copy), review by Babetski, in CIA *Studies in Intelligence* Vol. 56, No. 2
    - Kahneman, who won the 2002 Nobel Prize in Economics for his work with Tversky on prospect theory, also highlights the best work of other researchers throughout the book. *Thinking, Fast and Slow* introduces no revolutionary new material, but it is a masterpiece because of the way Kahneman weaves existing research together.
    - System 1, or fast thinking, operates automatically and quickly with little or no effort and no sense of voluntary control.
    - System 2, or slow thinking, allocates attention to the mental activities that demand effort, such as complex computations and conscious, reasoned choices about what to think and what to do.
    - Kahneman focuses much of the book on the interactions of System 1 and System 2 and the problems inherent in those interactions. Both systems are “on” when we are awake. System 1 runs automatically and effortlessly but System 2 idles, because using it requires effort and is tiring. System 1 generates impressions and feelings, which become the source of System 2’s explicit beliefs and deliberate choices. System 1, when it encounters something it cannot quickly understand and did not expect (in other words, a surprise), enlists System 2 to make sense of the anomaly. The alerted System 2 takes charge, overriding System 1’s automatic reactions. System 2 always has the last word when it chooses to assert it.

- Daniel Kahneman: The riddle of experience vs. memory - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
  - "Using examples from vacations to colonoscopies, Nobel laureate and founder of behavioral economics Daniel Kahneman reveals how our "experiencing selves" and our "remembering selves" perceive happiness differently. This new insight has profound implications for economics, public policy -- and our own self-awareness."
  - "Widely regarded as the world's most influential living psychologist, Daniel Kahneman won the Nobel in Economics for his pioneering work in behavioral economics -- exploring the irrational ways we make decisions about risk."

- Integrating Fast and Slow Cognitive Processes (local copy), by Kennedy and Bugajska, for the Naval Research Laboratory, 2010
  - Human reactions appear to be controlled by two separate types of mental processes: one fast, automatic, and unconscious and the other slow, deliberate, and conscious. With the attention in the literature focused on the taxonomy of the two processes, there is little discussion of how they interact. In this paper, we focus on modeling the slower process's ability to inhibit the fast process. We present computational cognitive models in which different strategies allow a human to consciously inhibit an undesirable fast response.

- Gladwell, Malcolm. *Blink: The Power of Thinking without Thinking*. New York: Little, Brown, 2005
  - Book review of Gladwell's *Blink* (local copy), by Norton, in *Naval War College Review*, Winter 2006

Intuition Top

The intuitive mind is a sacred gift and the rational mind is a faithful servant.
We have created a society that honors the servant and has forgotten the gift.
— Albert Einstein

- See also fast and slow thinking
- See also creativity and innovation
- See tactical decision games on the Simuations page, contrasting intuitive and analytic approaches
- See also - Recognition-Primed Decision Model - references in the Decision-Making section above
- See also situation awareness
- Todd Landman - Rational Intuition: Strategic thinking & gut instinct for successful leadership, video of speech plus Q&A, given at the RSA
- Developing Intuitive Decision-Making In Modern Military Leadership (local copy), by McCown, Naval War College, 27 Oct 2010
- Strategic Decision Games: Improving Strategic Intuition (local copy), by DeFoor, Joint Advanced Warfighting School, 23 Apr 2007
- Reforming Pentagon Strategic Decisionmaking (local copy), by Lamb and Lachow, INSS, Strategic Forum No. 221, July 2006
- How We Decide (local copy), by Schmitt, in *Designing TDGs: A Tactical Decision. Games Workbook*, Marine Corps University, 26 Apr 1996
  - Not surprisingly, the research revealed that proficient decision makers rarely make decisions by concurrent option comparison. Instead they use their intuition to recognize the essence of a given situation and to tell them what appropriate action to take. In fact, separate studies by Dr. Gary Klein and others conclude that decision makers in a variety of fields use the analytical apaproach to decision making less than 10 percent of the time and employ intuitive techniques over 90 percent of the time.
- Lee’s Mistake: Learning from the Decision to Order Pickett’s Charge (local copy), by Gompert and Kugler, *Defense Horizons* number 54, Aug 2006
- Custer in Cyberspace (local copy), by Gompert and Kugler, *Defense Horizons* number 51, Feb 2006

        - When conditions are complex and dynamic, time is short, and critical information is available, the key to making good decisions is to blend intuition with reasoning—more specifically, *reliable intuition* with *timely reasoning*.

    - From "The Personal Relevance of Great Campaigns" - by Bird, 22 Feb 2001, Command and General Staff Officer's Course
        - Carl Von Clausewitz explains that events in warfare are surrounded by uncertainty, and that there are few universal truths. Because of this, leaders must sort through this "fog" to find the truth, often a daunting endeavor that's permeated by chance. The commander must sift through this information and decide what pieces are relevant and require action. Clausewitz specifically refers to the capability of the mind to discriminate information allowing quick, correct decisions. He describes this ability as coup d'oeil, "the quick recognition of a truth that the mind would ordinarily miss or would perceive only after long study and reflection."[2] Napoleon faced such a scenario in the battles of Jena-Auerstadt. With limited information, he turned an entire field army in place to seek decisive battle with the Prussians and won the day. [[2]Carl Von Clausewitz, *On War*, ed. and trans. by Michael Howard and Peter Paret, (Princeton, NJ: Princeton University Press, 1976), p. 100-102.]

    - Coup D'Oeil: Strategic Intuition in Army Planning (local copy), by Duggan, Strategic Studies Institute (SSI), Nov 2005

    - Command Decision-Making: Experience Counts (local copy), by Wolgast, Army War College paper, 2005

    - Intuition: an Imperative of Command (local copy), by Rogers, in *Military Review* - examines relevance of intuition to decision making in the context of warfighting on the modern battlefield

    - Tactical Intuition (local copy), by Reinwald, in *Military Review*, Sep-Oct 2000

    - Intuition: An Instantaneous Backup System?, by Mrazek, in *Air University Review*

    - Decisionmaking Theory (local copy), Marine Corps Doctrine Publication 6
        - "the intuitive approach is more appropriate for the vast majority of typical tactical or operational decisions-decisions made in the fluid, rapidly changing conditions of war when time and uncertainty are critical factors, and creativity is a desirable trait"

        - Note 18. Intuitive decisionmaking more appropriate for the vast majority of tactical/operational decisions: A 1989 study by Gary A. Klein (based on 1985 observations) estimated that decision makers in a variety of disciplines use intuitive methods 87 percent of the time and analytical methods 13 percent of the time. Evidence now suggests that this study was actually biased *in favor of analysis*. More recent studies estimate the breakdown at more nearly 95 percent intuitive to 5 percent analytical. G. A. Klein, "Recognition-Primed Decisions" in William B. Rouse (ed.), *Advances in Man-Machine System Research* (Greenwich, CT: Jai Press, 1989); G. L. Kaempf, S. Wolf, M. L. Thordsen, and G. Klein, *Decision Making in the Aegis Combat Information Center* (Fairborn, OH: Klein Associates, 1992); R. Pascual and S. Henderson, "Evidence of Naturalistic Decision Making in Command and Control" in C. Zsambok and G. Klein (eds.), *Naturalistic Decision Making*, forthcoming publication (Hillsdale, NJ: Lawrence Erlbaum Associates); Kathleen Louise Mosier, *Decision Making in the Air Transport Flight Deck: Process and Product*, unpublished dissertation (Berkeley, CA: University of California, 1990).

    - Decision Making Theory (local copy), Naval Doctrine Publication 6, Naval Command and Control
        - "The intuitive approach is clearly more appropriate for the fluid, rapidly changing environment of combat, when time and uncertainty are critical factors."

    - The Warning Process and the Role of Intuition (local copy), course module from NOAA

    - Intuitive Policing - Emotional/Rational Decision Making in Law Enforcement (local copy), by Pinizzotto et al, in the *FBI Law Enforcement Bulletin*, February 2004

    - Cultivating Intuitive Decisionmaking (local copy), by Krulak, in *Marine Corps Gazette*, May 1999, as posted on the USMC Commandant's Page

    - War in the Pits: Marine-Futures Traders Wargame (local copy), NDU Strategic Forum 61, by West
        - Marine generals and colonels vs futures traders in decisionmaking wargame
        - "The traders' OODA loop, executed at much higher speed, is ISAA: Information, Sort by Priority, Act, Assess"
    - Virtual Stress (local copy), in *Marines Online*, senior Marines vs futures traders in decision making wargame

    - Intuitive people worse at detecting lies, by Young, NewScientist.com, 18 Mar 2002
        - People who think of themselves as being intuitive make worse lie detectors than those who do not trust in a "gut instinct", according to new research.
        - One possible explanation is that intuitives in fact rely on common misconceptions about how to spot a liar, he says.

Situation Awareness, Situational Awareness Top

To see, to hear, means nothing. To recognize (or not to recognize) means everything.
— Andre Breton

- See also Intuition above

- See also Predictive Battlespace Awareness (PBA)

- Individual Situation Awareness (local copy), course module from NOAA
    - Situation Awareness Definition (from Mica Endsley, 1988)
        - Level 1 - **Perception** of the elements in the environment within a volume of space

        - Level 2 - **Comprehension** of their meaning
        - Level 3 - **Projection** of their status in the near future

- Team Situation Awareness (local copy), course module from NOAA

- Situation Awareness Demons: the Enemies of Situation Awareness (local copy), course module from NOAA
    - Discusses the eight demons laid out by Endsley et al, in "Designing for Situation Awareness"
        - Attentional Tunneling
        - Requisite Memory Trap
        - Workload, Anxiety, Fatigue, and Other Stressors (WAFOS)
        - Data Overload
        - Misplaced Salience
        - Complexity Creep
        - Errant Mental Models
        - Out-of-the-Loop Syndrome

Ye Olde Brain, and Its Workings Top

The destiny of every human being is decided by what goes on inside his skull when confronted with what goes on outside his skull.
— Dr. Eric Berne

I know you think you understand what you thought I said but I'm not sure you realize that what you heard is not what I meant.
— Alan Greenspan

- Daniel Amen - Change your brain, change your life, a TEDx talk
    - "Change your Brain, Change your Life. Revelations based on studying 63,000 brain images across 90 countries over 20 years. How Brain imaging can change paradigms and our understanding of healthy life, no matter where we live."

- Steve Ramirez and Xu Liu: A mouse. A laser beam. A manipulated memory - a TED talk (you may need to watch it on YouTube if TED videos are blocked)
    - "Can we edit the content of our memories? It's a sci-fi-tinged question that Steve Ramirez and Xu Liu are asking in their lab at MIT. Essentially, the pair shoot a laser beam into the brain of a living mouse to activate and manipulate its memory. In this unexpectedly amusing talk they share not only how, but -- more importantly -- why they do this. (Filmed at TEDxBoston.)"

- From Bench to Bunker: How a 1960s discovery in neuroscience spawned a military project, by Bardin, in *The Chronicle of Higher Education*, 9 July 2012
    - The man has a machine strapped to his head, an array of electrodes called an electroencephalogram, or EEG, which is recording his brain activity as each image skips by. It then sends the brain-activity data wirelessly to a large computer. The computer has learned what the man's brain activity looks like when he sees one of the visual targets, and, based on that information, it quickly reshuffles the images. When the man sorts back through the hundreds of images—most without structures, but some with—almost all the ones with buildings in them pop to the front of the pack. His brain and the computer have done good work.
    - That display was a demonstration of a new technology being developed through a collaboration between the Defense Advanced Research Projects Agency, the military's research arm, and a private company called Neuromatters, which was founded by a team led by the Columbia University bioengineer Paul Sajda. The hope is that, in the near future, military analysts might use the technology to eliminate worthless images in seconds, speeding up their review of satellite images by orders of magnitude. By the looks of it, it's working.

- Paolo Cardini: Forget multitasking, try monotasking, a talk from TED.com - if TED site is blocked, you may be able to watch it on YouTube or one of the other sites
    - People aren't just cooking anymore -- they're cooking, texting, talking on the phone, watching YouTube and uploading photos of the awesome meal they just made. Designer Paolo Cardini questions the efficiency of our multitasking world and makes the case for -- gasp -- "monotasking."

- Amy Cuddy: Your body language shapes who you are, a talk from TED.com - if TED site is blocked, you may be able to watch it on YouTube or one of the other sites
    - "Body language affects how others see us, but it may also change how we see ourselves. Social psychologist Amy Cuddy shows how "power posing" -- standing in a posture of confidence, even when we don't feel confident -- can affect testosterone and cortisol levels in the brain, and might even have an impact on our chances for success."
    - "Amy Cuddy's research on body language reveals that we can change other people's perceptions — and even our own body chemistry — simply by changing body positions."

- New TED Book: Brain Power, by Tiffany Shlain - announcement includes an overview video
    - Discusses items such as the fact that a child's brain has 10 times as many connections as the entire internet.

- Shifting Your Brain: Anders Sandberg at TEDxTallinn - video - turning technology inward to change ourselves

- Left-Brain/Right-Brain (local copy), from Army ROTC "Foundations for Success"

- Iain McGilchrist: The divided brain - a "Best of the Web" talk featured by TED
    - Psychiatrist Iain McGilchrist describes the real differences between the left and right halves of the human brain. It's not simply "emotion on the right, reason on the left," but something far more complex and interesting. A Best of the Web talk from RSA Animate.

- Scott Fraser: Why eyewitnesses get it wrong, a talk from TED.com (but you may need to watch it on

YouTube if the TED.com version won't run on your computer)
    - "Scott Fraser studies how humans remember crimes -- and bear witness to them. In this powerful talk, which focuses on a deadly shooting at sunset, he suggests that even close-up eyewitnesses to a crime can create "memories" they could not have seen. Why? Because the brain abhors a vacuum."
- Tan Le: A headset that reads your brainwaves, a talk from TED.com (but you may need to watch it on YouTube if the TED.com version won't run on your computer)
    - "Tan Le's astonishing new computer interface reads its user's brainwaves, making it possible to control virtual objects, and even physical electronics, with mere thoughts (and a little concentration). She demos the headset, and talks about its far-reaching applications."
- Rebecca Saxe: How we read each other's minds, a talk from TED.com (but you may need to watch it on YouTube if the TED.com version won't run on your computer)
    - "Sensing the motives and feelings of others is a natural talent for humans. But how do we do it? Here, Rebecca Saxe shares fascinating lab work that uncovers how the brain thinks about other peoples' thoughts -- and judges their actions."
- Kwabena Boahen on a computer that works like the brain, a talk from TED.com (but you may need to watch it on YouTube if the TED.com version won't run on your computer)
    - "Researcher Kwabena Boahen is looking for ways to mimic the brain's supercomputing powers in silicon -- because the messy, redundant processes inside our heads actually make for a small, light, superfast computer."
- Diane Benscoter on how cults rewire the brain, a talk from TED.com (but you may need to watch it on YouTube if the TED.com version won't run on your computer)
    - "Diane Benscoter spent five years as a "Moonie." She shares an insider's perspective on the mind of a cult member, and proposes a new way to think about today's most troubling conflicts and extremist movements."
    - talks about viral memetic infections and compromised emotional immune systems
- Al Seckel says our brains are mis-wired, a talk from TED.com (but you may need to watch it on YouTube if the TED.com version won't run on your computer)
    - "Al Seckel, a cognitive neuroscientist, explores the perceptual illusions that fool our brains. Loads of eye tricks help him prove that not only are we easily fooled, we kind of like it."
- Steven Pinker on language and thought, a talk from TED.com (but you may need to watch it on YouTube if the TED.com version won't run on your computer)
    - "In an exclusive preview of his book The Stuff of Thought, Steven Pinker looks at language and how it expresses what goes on in our minds -- and how the words we choose communicate much more than we realize."
- Keith Barry does brain magic, a talk from TED.com (but you may need to watch it on YouTube if the TED.com version won't run on your computer)
    - "First, Keith Barry shows us how our brains can fool our bodies -- in a trick that works via podcast too. Then he involves the audience in some jaw-dropping (and even a bit dangerous) feats of brain magic."

- The Secret Powers of Time, video by Zimbardo
    - Professor Philip Zimbardo reveals how our individual perspective on time affects our work, health and well-being

- Mind Reading Machine on CBS Reads Your Thoughts - (10 out of 10 at guessing what a scanned person is thinking about) – also reading/assessing “intentions” and being able to assess if you’ve been somewhere before (for example, when you were robbing the house) and neural marketing – and brain patterns indicating various emotions

- Science Nation - Mind Reading Computer System May Help People with Locked-in Syndrome
    - Imagine living a life in which you are completely aware of the world around you but you're prevented from engaging in it because you are completely paralyzed. Even speaking is impossible. For an estimated 50,000 Americans this is a harsh reality. It's called locked-in syndrome, a condition in which people with normal cognitive brain activity suffer severe paralysis, often from injuries or an illness such as Lou Gehrig's disease. Boston University neuroscientist Frank Guenther works with the National Science Foundation's Center of Excellence for Learning in Education, Science and Technology (CELEST), which is made up of eight private and public institutions, mostly in the Boston area. Its purpose is to synthesize the experimental modeling and technological approaches to research in order to understand how the brain learns as a whole system. In particular, Guenther's research is looking at how brain regions interact, with the hope of melding mind and machine, and ultimately making life much better for people with locked-in syndrome.

- Department of Brain and Cognitive Sciences, MIT
    - brain and cognitive sciences - course materials free from the MIT Open CourseWare Project
- MIT CogNet: the Brain Sciences Connection

- Psychology of Intelligence Analysis (local copy), by Heuer, 1999, for CIA -- very good examination of many elements of critical thinking and mental processes, with examples (PDF version)

- Complexity, Conflict Resolution, and How the Mind Works, by Jones and Hughes, in *Conflict Resolution Quarterly*, Summer 2003

- Semiotic Fundamentals of Information Processing in Human Brain (local copy), by Perlovsky, Air Force Research Lab
    - The paper discusses a mathematical nature of signs and symbols, and relates it to information processing and understanding, structure of the mind and brain, learning, and pattern recognition.

- Quantum Theory and the Role of Mind in Nature (local copy), by Stapp, Lawrence Berkeley Laboratory
- On Quantum Theories of the Mind (local copy), by Stapp, Lawrence Berkeley Laboratory
- A Quantum Theory of the Mind-Brain Interface (local copy), by Stapp, Lawrence Berkeley Laboratory
- The Evolution of Consciousness (local copy), by Stapp, Lawrence Berkeley Laboratory

- Values and the Quantum Conception of Man (local copy), by Stapp, Lawrence Berkeley Laboratory
- additional work by Stapp

Videos for Thinking & Innovating Top

Many videos from the following sources are scattered throughout this website. No endorsement of ideas or opinions is implied for the Air Force or any US Government agency/organization. These are for your personal interests and education only.

- TED talks - over 1,200 videos, from 3 minutes to 25 minutes, by leading thinkers and developers in many fields of study
  - "TED is a nonprofit devoted to Ideas Worth Spreading. It started out (in 1984) as a conference bringing together people from three worlds: Technology, Entertainment, Design. Since then its scope has become ever broader."
  - if the TED website copy of the video doesn't play on your computer, cut and paste the title of the talk into a search engine to find the YouTube copy or other copy which may play.

- The RSA (Royal Society for the encouragement of Arts, Manufactures and Commerce)
  - "an enlightenment organisation committed to finding innovative practical solutions to today's social challenges"
  - over 400 videos, animations, shorts, and more
  - RSA Animate takes select speeches and adds entertaining animation effects

- 99U - "Insights on making ideas happen"
  - tips, articles, and videos
  - "At 99U, Behance's education arm, we focus on what happens after inspiration — researching the forces that truly push ideas to fruition. Our profiles of proven idea makers, action-oriented tips, and annual conference are all designed to help you transform ideas from vision to reality."

- PopTech videos
  - "We're a global community of innovators, working together to expand the edge of change."

- *MIT Technology Review* videos

- DARPA TV on Youtube

Miscellaneous Top

- Thinking in a Foreign Language Makes Decisions More Rational, by Keim, in *Wired* online journal, Apr 2012
  - A series of experiments on more than 300 people from the U.S. and Korea found that thinking in a second language reduced deep-seated, misleading biases that unduly influence how risks and benefits are perceived.
  - The researchers believe a second language provides a useful cognitive distance from automatic processes, promoting analytical thought and reducing unthinking, emotional reaction.

- Altering Leadership Thinking And Organizational Behavior Through Web Services (local copy), by Gilbert, DAU Senior Service College Fellowship, Apr 2010

- Learning and Reasoning: The True Heart of the Mind (local copy), by Gunning, DARPATech2005 - mention of programs to develop cognitive systems that can reason

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