From the Editor's Desk

Frank Fair

Peter and Noreen Facione lead off this issue with their reflection piece "Critical Thinking for Life: Valuing, Measuring, and Training Critical Thinking in All Its Forms." In this article Peter and Noreen chronicle the course of their collaboration in which they have attempted to construct credible conceptions of what critical thinking is, of how to measure both its skill and dispositional aspects, of how it is valuable, and of how people can be trained in it so that they may have better lives. They structure their presentation around a series of questions, beginning with a set of initial motivating questions such as "Why do smart, well-informed people make poor judgments and stick with them, even in high stakes situations involving both risk and uncertainty?" These motivating concerns lead them to ask a number of scholarly questions, one of which about the meaning of "critical thinking" resulted in the well-known American Philosophical Association (APA) Delphi Project. This project, under Peter's leadership, developed a consensus definition of critical thinking and related concepts, a definition which Peter and Noreen continue to reference in their work.

There are also a number of practical concerns that guide their work. One is how to do credible assessment of critical thinking. In response they have developed a number of instruments, the best known of which are the California Critical Thinking Skills Test (CCTST) and the California Critical Thinking Dispositions Inventory (CCTDI). I have the distinct impression that these are the two instruments most widely used around the globe to measure critical thinking skills and the relevant critical thinking dispositions. If they had accomplished nothing more than this, Peter and Noreen would greatly deserve our appreciation for their work. But they have not stopped, and two recent works in particular exhibit their continuing efforts: (1) a 2007 treatise, *Thinking and Reasoning in Human Decision Making: The Method of Argument and Heuristic Analysis,* and (2) a 2013 textbook by Peter and coauthor Carol Gittens, *THINK Critically*, 2nd ed.

And so it happens that *THINK Critically* is the subject of a review by Benjamin Hamby. Ben's review is thoroughgoing, and he describes in detail a number of features that, in his opinion, lift the textbook well above its run-of-the-mill competitors. In Ben's words: "This is a textbook that breaks the mold of traditionally conceived critical thinking pedagogy. The format is fresh and original, the content relates to real-life problems in decision and judgment making, and the conception of critical thinking is reinforced by important scholarship."

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Critical Thinking for Life: Valuing, Measuring, and Training Critical Thinking in All Its Forms

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Abstract

This essay describes the questions which shaped and continue to fuel Peter and Noreen Facione's passionate involvement with critical thinking, its definition, measurement, training, and practical application to everyday decisions, big and small. In reflecting on their work they say "we have identified three groups of questions: those vexing, recurring questions that motivate us to explore critical thinking, those scholarly questions around which we organized our empirical and conceptual research, and those urgent practical questions which demand the development of applications and assessment solutions. We conclude with two recommendations for the consideration of all those who value fair-minded, well-reasoned, reflective decision making."

Keywords: critical thinking, APA Delphi Project report, measuring reasoning skills, thinking mindset, heuristic thinking, argument mapping, reflective judgment, decision errors, learning outcomes assessment, CCTST, CCTDI, INSIGHT test, Facione

I. Introduction

We are honored to receive Frank Fair's unexpected invitation to reflect on our involvement with critical thinking, and thank him, the editorial board, and the publishers of *INQUIRY* for this singular opportunity to share our views, experiences, questions, and recommendations. To teach for thinking is to free minds – developing critical thinking skills and cultivating positive critical thinking habits of mind is the single most liberating aspect of becoming educated. To promote critical thinking is to give individuals and groups the power and the permission to engage their problems, issues, and concerns in the most responsible, effective and self-correcting way that our species has as yet discovered. We've written this essay to show our profound solidarity with all who would shine a light into the shadows of prejudice, would shred the drapes of ignorance, and would follow reasons and evidence wherever they may lead vigorously and with courage, and teach others to do the same, Our work is built on collaborations with those countless other scholars whom we have met on this journey, and we thank them all.

We have organized this essay loosely around groups of questions, because questions, both practical and abstract, have always driven our thinking and our collaborative work. There are more biographical comments here than in our other writings, but we hope that this story will help others to see the rich opportunities that come from the interaction of two very different research perspectives coming together in one focused team.

II. Motivating Questions

Perhaps it was the mid-twentieth century boarding school experiences we both separately endured, Peter in the US and Noreen in Great Britain, or perhaps it was throwing off the role expected of the eldest child during the Ozzie-and-Harriet era, but whatever it was, we each became fascinated with how people made decisions. What they thought about. What they regarded as important vs. unimportant. How they dealt with objections, incomplete information, preconceptions. What thinking processes they said they used vs. what processes they appeared to be actually using.

Like many of you, we were watchers of thinking and decision-making while growing up. We saw that many humans made probabilistic judgments and then defended them as gold-plated certitudes. We saw that many were unaware of the limits of their personal perspectives and proudly proclaimed that their views were, or ought to have been, universally held. We saw anecdotes being treated as datasets. We saw conclusions surviving long after all their supporting reasons had been refuted. But then, infallibility has always been in short supply. As we became aware of incongruities we wondered why. How could he or she think that, say that, decide that, approach the problem that way?

The question that motivates us as a team to explore the science around naturalistic human decision making is this: Why do smart, well-informed people make poor judgments and stick with them, even in high stakes situations involving risk and uncertainty? Like all good questions, it has a very long answer, some of which we have come to know.

Pivotal examples of our driving question emerged constantly during our respective professional careers: Noreen's as a clinician, educator, behavioral science researcher, and then academic administrator and business leader, Peter's as educator, dean, executive and then strategic consultant. Why, for example, do some health care providers stick with a treatment plan aimed at a cure long after the cure potential has slipped away? Why do managers follow a multi-year strategic plan when market conditions indicate that the plan's assumptions are no longer valid? Why do academic departments propose to use their scarce resources in ways that consistently generate metrics that fail to meet targeted outcomes? Why do so many seemingly mature and secure adults find it difficult or unnecessary to voice their disapproval and disgust for the workplace bully and the family bigot?

These days in our workshops we ask the question in this less confrontational way: What happens when critical thinking fails? It does not take long before people realize that the list of unfortunate and potentially avoidable outcomes is nasty and long. It includes patient deaths, lost revenue, traffic accidents, combat casualties, garbled communications, wrongful imprisonment, unplanned pregnancies, ineffective planning, family strife, wasteful spending, virulent extremism, academic failure, and more.

In earlier years, we did not dwell much on the cost of poor critical thinking to society. This insight came later, as we became more aware that failure to frame a problem correctly, to open-mindedly examine options, or to correctly infer likely consequences, were the real sources of the misfortunes that ultimately resulted. Our realization was affirmed as we began to see the data showing how poorly humans actually think and as we came to appreciate the magnitude of the challenges associated with training strength in thinking skills and habits of mind. Like most early career researchers, our first work was descriptive, focusing on specific issues of more immediate concern: How can we make better judgments as parents? And how can we teach our children to make good judgments about what they should do and what they should believe? How can we, as an academic department, make better judgments about the direction of our curriculum or about future hiring?

III. Scholarly Questions

A. The Scholarship of Teaching

Peter's questions first found expression in the scholarship of teaching. As a young faculty member and department chair at Bowling Green State University in Ohio, he assigned himself to teach large-lecture courses each year. Was it possible to build students' reasoning skills in a large lecture environment? And if so, how?

One of the large lecture courses Peter taught was the Intro to Logic course. The chief goal of the course was to develop stronger reasoning skills in students. In 1974, he and his Philosophy Department colleague, Don Scherer, were awarded a grant by the Exxon Education Foundation to introduce computer-assisted instruction into the large lecture logic course. Typical for its era, the catalogue described the course as covering propositional logic, first order logic, and the formal and informal fallacies. The Exxon project first required developing student-focused instructional objectives framed using active verbs like "analyze," "infer," "evaluate," and "explain." The next step was to develop valid and reliable questions in a closed frame format that would allow us to assess each student's progress on each instructional objective in real time. The third step was to figure out how to get each student the specific instructional support that would be most helpful.

Needless to say, implementing these steps called for changing how the course was delivered. Instead of the instructor delivering three 50-minute lectures followed by one 50-minute study session led by graduate assistants each week, those 200 minutes needed to be used differently so that frequent quizzes graded by the huge campus mainframe could assist getting the needed instruction to the right students each week. The format that worked best involved students completing a 20-minute short multiple-choice quiz on Monday, followed by a mini lecture addressing only the most difficult parts of the material. Overnight the mainframe processed the quizzes. Early Tuesday, each of the 300-350 students could pick up his or her individualized printout assigning each person to a Tuesday study group on the basis of their quiz results. The computer sorted students into three ability groups based on the previous day's quiz. Teaching assistants were trained to handle the expected needs of the three different ability groups and were dispatched to run those study groups that day. Thursday the whole class met again in the large lecture hall and the process was repeated: short quiz and mini-lecture on Thursday. Quizzes graded overnight and students sorted by quiz scores into ability level study groups led by teaching assistants on Friday. 150 minutes of lecture time and a single heterogeneous review session each week became two short quizzes, two mini-lectures, and two homogenous study groups per week. This was the teaching, learning, and assessment procedure for the entire term, except for the mid-term and final exams. Result? The syllabus expanded to twelve chapters as compared to the previous ten, and the mean scores on the course final exam increased by several points over the mean scores in prior terms. The program continued for quite a few years until Peter moved on to a Deanship at California State University Fullerton (CSUF), and Don pursued new opportunities in applied Philosophy, eventually becoming one of the first to advocate for climate concerns and environmentalism. A more complete account of the course can be found in an interview with Peter Facione and Don Scherer reported by Henry Weil in *Change* (Weil, 1977).

Perhaps the most important learning from the Exxon project for Peter was that many of his assumptions were mistaken about teaching for thinking, about how students

can manifest their thinking skills for purposes of valid and reliable measurement, and about the profession's readiness to reconsider the structure and content of the classic "baby logic" course. The evidence was right there. *To teach critical thinking more effectively, talk less about it and instead engage students more in applying their thinking skills.* And while thinking skills can certainly be manifested in essays, discussions and projects, they can be captured by objective questions too, provided that the questions are very well designed. Moreover, the data from well-designed assessments could inform what is taught and thus advance student learning.

However, in December of 1975 there was no stomach at the Eastern Division meeting of the American Philosophical Association (APA) for any discussion about the objective testing of students' reasoning skills. That year, the audience for the paper that Scherer and Facione presented was vocal in its ridicule of the very idea that thinking skills could even be assessed, and openly skeptical about the claim that students might learn more if instructors lectured less (Facione & Scherer, 1975). Those colleagues at that time, all those decades ago, saw themselves as delivering information about how students might improve their thinking. The pedagogical assumption of the time was that it was then up to the students to figure out how to apply that information.

The Exxon project took place at Bowling Green State University, an institution that funded its departments based on student credit units generated. Other departments with small numbers of majors had secured guaranteed enrollments through required courses in the campus general education requirements. The Philosophy Department was not one of those. With survival on the line, it developed a strategic plan in the mid-to-late 1970's that depended on sponsoring a wide variety of very popular applied philosophy service courses. Among the more successful were courses in environmental ethics, medical ethics, philosophy of feminism, philosophy of death and dying, and the morphing of the baby logic course into a critical thinking course. Scherer and Facione authored a textbook based on that course. The book's working title was *Logic and Critical Thinking*. McGraw Hill eagerly signed the authors but insisted that the title of the published book be changed to *Logic and Logical Thinking*. Why? The editors at McGraw Hill were convinced that the term "critical thinking" was nothing but a fleeting bit of academic jargon. The book did not do well. But the Philosophy Department did, and its commitment to the practical applications of philosophical skills and knowledge at the undergraduate and graduate levels enabled it to flourish for decades.

B. Our Collaboration Begins

If we were asked to identify in retrospect when our collaborative research work really began, the answer would be in 1978. As a Masters degree student, Noreen was looking for a research methodology to study how well people were accepting the delivery of health care services by the new "nurse practitioner" provider group. Peter knew of a method developed by the RAND Corporation in the 1950's designed to achieve an expert consensus about a particular research question, the Delphi Method. The researcher's role in a Delphi Study is to compile input from all experts, and by seeking clarification and consensus through multiple iterations to arrive at a consensus, but at the same time to refrain from adding personal input to the study. This method allowed every participant an equal voice in the outcome, balancing the voices of those who may otherwise have had a greater influence through their larger reputation. The resulting publication of the study we published several years later assuring that nurse practitioners would be well received as care providers (Facione, N. & Facione, P., 1985) is one that would hardly be needed today, as now there are well over 100,000 nurse practitioners providing care in the US (AHRQ, 2010).

With exposure to Peter and Don Scherer's work on training reasoning skills, the connection between critical thinking skills and developing strength in diagnostic reasoning was already evident to Noreen, who was first a critical care nurse at the Medical College of Toledo (Ohio) and Irvine Medical Center (California), and later a nurse practitioner, working with two ENT surgeons in a busy Otorhinolaryngology (ENT surgical) practice in Orange, CA. Stan Siegel, MD, Ed Kravitz, MD, and Noreen saw patients of all ages, often more than 40 per day. ENT is a broad clinical specialty, and their practice provided care for deafness (early cochlear implant surgery), genetic syndromes and congenital anomalies (head and neck surgical repairs), cancer (head and neck tumor surgeries), and surgical treatment for numerous common ailments of the head and neck.

Patient decision making was to become a major theme in Noreen's research. In those years, among her diverse patient care population there were patients who presented with advanced cancers of the head and neck. These cases intrigued Noreen above all others, and focused her clinical research on the decisions that people make in response to self-discovered illness symptoms. How did patients analyze their symptoms? Did patients know the gravity of their condition? What determined the timing of their first diagnostic visit? The prevailing wisdom was that people were ignorant when it came to recognizing cancer symptoms, or that people subconsciously denied their symptoms. But talking with patients about the progression of their symptoms and how they decided to finally seek a diagnosis suggested that the story of advanced cancer at the time of diagnosis was more complicated and more reflective. Earlier detection of head and neck cancers (and cancer in general) saves lives and diminishes disfigurement.

In the spirit of following reasons and evidence wherever they lead (a habit of mind we later called "truthseeking"), Peter suggested that they both relocate to Northern California where Noreen could pursue her work in cancer

early detection at the University of California San Francisco. UCSF was at that time the top nursing doctoral training program in the US, and it remains a national leader in research and clinician training. In 1990, Peter began his years as Dean of Arts and Sciences at Santa Clara University. And with the mentorship of Dr. Marylin Dodd, Noreen secured a Regent's fellowship for doctoral study and a National Institutes of Health (NIH) training grant to pursue research in "patient decision making." Dissertation study at UCSF offered unlimited opportunity to augment standard coursework, and, seeing a need for new instrument development in the measurement of attitudes related to patient decision making, Noreen added psychometric training at Stanford University under their collaborative agreement with UCSF.

After earning her Ph.D., Noreen stayed on at UCSF, teaching courses in research methods and cancer while pursuing her research and serving as Director of the Cancer Nursing Program. Later she had the amazing opportunity to develop the UCSF Genetics Nursing Program, with funding from the Health Resources Services Administration (HRSA) of the Federal Bureau of Health Professions (Facione, N., 2001). You may be wondering "Genetics? Where did that come from?" It's amazing what can happen when your department chair comes calling. Noreen's chair, Dr. Christine Miaskowski, was a researcher with the National Institutes of Health, and Chair of the American Pain Society. She and Dean of the Nursing School, Dr. Jane Norbeck, knew that the Nursing faculty then had little knowledge of emerging genetics science. They asked the difficult question: How can we stay abreast of the quickly developing science that is genetics? Their response was that the Nursing School needed a program to train graduate student clinicians and our own faculty, and they asked Noreen to work on that for the school.

Noreen's research on decision-making in health contexts continued in spite of active teaching and service assignments. She led studies funded by the NIH, the American Cancer Society, and the California Tobacco Tax Initiative which provided much new insight into how people become aware of potentially serious symptoms and decide whether to seek care. This research became widely cited as a break-through analysis of the phenomenon otherwise known as "patient delay," in not just cancer but also heart disease. Why? Perhaps because it was the first research to connect patient delay to reasoned decision making, and because it added to the science that suggested early detection interventions should be aimed at this judgment process (Facione, N. C. et al., 1997; Facione, N. C., 2002a; Facione, N. C., 2002b).

There is nothing better than to share a common interest with your spouse. As the years have gone by, we have spent countless hours together analyzing arguments, decision data, and the validity and reliability of new measurement tools. In time we each became the most dedicated research partner, one that the other could depend on to be well versed in decision science. Understanding how people make high stakes judgments under uncertain conditions, and learning how to capture evidence of attitudes and values that influence the decision process, led both Noreen and Peter to learn about intelligence theories and decision theories, and the emerging observations about heuristic reasoning. Some of the researchers and theorists that influenced us most were Triandis (1980), Ajzen and Fishbein (1980), Kahneman, Slovic, and Tversky (1982), and a remarkable book by Montgomery and Svenson (1989) where we learned why no one ever changes their mind. We also dug deeply into survey item construction techniques, new statistical methods for managing and analyzing large datasets, and published insights on the development of culturally competent measurement tools.

The results were a number of decision-focused papers that examined evidence of heuristic reasoning in health related decision making. (Facione, N. C. & Facione, P.A. (2001); Facione, N. C. & Facione, P. A. (2002); Facione, N. C. & Facione, P. A., (2006)), and the development of an advanced argument mapping technique that we call "Argument and Heuristic Analysis" and that we believe advances the ability to analyze the reasoning process used in authentic high-stakes decision processes (Facione, P. A. & Facione, N. C., 2007). The techniques of Argument and Heuristic Analysis capture not only the conscious decision path and reasons a person expresses in support of their choice, but also enable the investigator to map the subject's heuristic thinking and those abandoned and underdeveloped reasoning strands – strands than can be lost or buried when a person is striving to bolster a particular conclusion, or simply thinking poorly. But more on this later.

C. What do we mean by "critical thinking"?—the APA Delphi Project

How did the APA Delphi study come about? By the mid-1980's, after serving as Dean of a professional school that was an aggregation of education and human services disciplines, Peter was regularly teaching a graduate course in behavioral research methods and statistics at California State University Fullerton. The course trained critical thinking skills by focusing on evidence-based approaches to examining questions about educational practices. A person can train critical thinking in any subject domain by guiding students to apply their critical thinking skills and mindset to genuine questions in that domain. Yes, as everyone who has studied inferential statistics or practiced any of the arts or sciences knows, some methodologies are more appropriate for one domain than another. But, that said, at the heart of all inquiry one finds fundamental reasoning skills such as (1) analysis, (2) interpretation, (3) inference, (4) evaluation, (5) explanation and, most important, (6) reflective self-correction. These skills can be applied not only to the questions that a given domain of learning or practice addresses, but also to the very methods, concepts, theories, and evidence which constitute the

discipline that is that domain of learning or practice. But, coming to this realization required the metamorphosis that was the APA Delphi Project. For a graphic representation of these skills see Figure 1 below. The image is spherical to express the iterative nature of these skills. One can interpret explanations, explain analyses, evaluate the analysis of inferences, and so on.

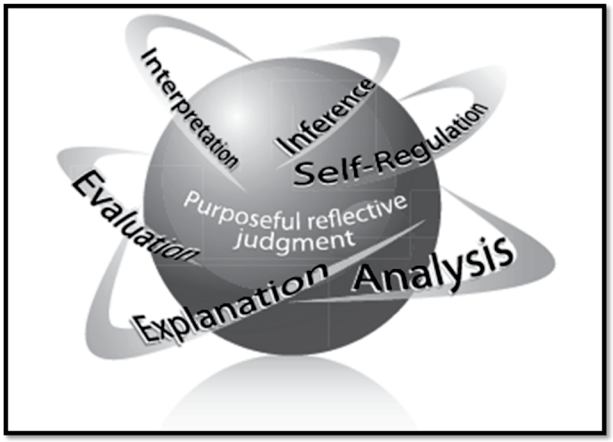


Figure 1: Core critical thinking skills fire in a non-linear and potentially recursive way

Throughout the decade of the 1980s, leading figures in the critical thinking movement wrote articles seeking to differentiate their views about critical thinking from the views of other experts. But why continue doing that, when they agreed on the basic ideas, and their purposes converged as well? They all were interested in helping people to become more effective thinkers, better at making reflective decisions, better at addressing life's problems with reasons and evidence, and better at resisting specious or fallacious reasoning. Why all the quibbling and logic chopping when there was more that united those experts than divided them? Like others, Peter had published articles describing his understanding of the construct. But those who reviewed that literature did not come away impressed with the strong accord that could be detected, instead they inferred that because the experts disagreed it was fine for anyone and everyone to propose their own esoteric or idiosyncratic definitions (Gainer, 1988). Had McGraw Hill's editors been correct? Was the term nothing more than momentary academic jargon? Worse yet, some were beginning to leverage the term to their own advantage (a tactic that continues today). They lauded all and only the thinking that supported their own interests and their own point of view. "Agree with me and you're a good critical thinker, otherwise not!" That kind of sophistry could not be allowed to stand, and the experts knew it.

Beginning in this same 1980s timeframe (and continuing to the present), campus after campus looked to reform its general education requirements, to articulate core learning outcomes, and to explain to students, accrediting agencies and the general public the practical value of its baccalaureate requirements. To do this, general education committee after general education committee confronted questions like these: "We know it is important, but what exactly do we mean by the term 'critical thinking' and how will we measure it?" Often the solution to the definitional part of the question was to craft a local definition, one that suited the intellectual assumptions and political realities of the local faculty senate. Typically this took an entire academic year or more, setting back the discussion of assessment and delaying the articulation of quantifiable learning objectives indefinitely. "Critical Thinking" risked becoming lost in the culture wars, the campus politics, and the political correctness that demanded knee-jerk cynicism about learning outcomes assessment.

For a decade or more, Peter and other scholars had been tracking the movement in higher education toward outcomes-based general education requirements (Facione, P. A. et al., 1980). One of the broad learning outcomes on almost every university's list was (and still is) critical thinking. But who would be teaching critical thinking, given the budgetary constraints higher education was facing and given the reluctance of educational leaders to launch new academic departments, programs, or courses simply for that purpose? The disciplines were merging and morphing. It was a new ball game. Along with everything else, the shift toward collaborative inquiry and allure of external funding made it clear that the focused training of critical thinking skills could not be contained within any one department. If several departments could contribute courses to meet requirements in quantitative reasoning and professional ethics, then why not contribute critical thinking courses too? And anyway, it was often said, nobody really knows what "critical thinking" means. Every faculty member believed she or he was teaching students to reason well. And every faculty member believed that he or she based grades on how well the students demonstrated good thinking. That there was no objective evidence to support either of these latter two claims was not deemed sufficient reason not to embrace them as gospel.

"So what's the problem, Pete? Are you saying that our local definition isn't good enough? Are you some kind of trouble maker? Don't upset the political equilibrium with your ideas about a research-based expert consensus definition of critical thinking. You'll never get an ornery bunch of philosophers and theoreticians to agree. And we have no budget anyway, so don't come around here looking for funding!"

Peter sought the assistance of the Chair of the American Philosophical Association (APA) Committee on Pre-College Philosophy. Something needed to be done to clarify and reach consensus on what was meant by "critical thinking" before the term had to be abandoned as nonsensical. Having just witnessed Noreen's Delphi study of attitudes about nurse practitioners (Facione, N. & Facione, P., 1985), he knew he could use RAND's Delphi method to help the experts achieve a consensus definition

of critical thinking, unbiased by the relative celebrity status of any one current spokesperson. Once this was done, all could focus on the question that really mattered: How can we better train and assess critical thinking?

Critical thinking in K-12 education had long been an interest of that committee. Perhaps the committee would agree to endorse a project aimed at higher education. And it did. Peter, as the Principal Investigator, managed the communications among the panelists and drafted for the panel's consideration the syntheses of their views and comments. But Peter was not, himself, one of the Delphi Project expert panelists. In the end the APA Delphi Project Report emerged out of the hope shared by many experts that the sought-for working consensus could be achieved. Its title, "Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction," reflects its very practical aims (Facione, P. A., 1990). The project revealed that there was sufficient expert accord about what "critical thinking" meant that it was reasonable to move forward with curricular programs aimed at developing students' critical thinking and to move forward with assessment strategies aimed at measuring students' critical thinking at the college level. Through the process, Peter came to embrace completely the consensus accord which the experts were articulating. Among other things, the experts offered a definition of critical thinking, a description of the ideal critical thinker, a listing of core critical thinking skills and sub-skills, and an extensive list of student work products that might be expected to manifest or employ each skill and sub-skill. See Figure 2 below for the one sentence summary of the definition that emerged from the process.

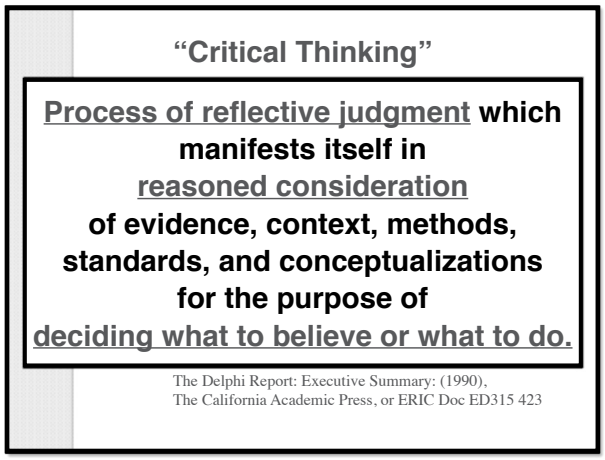


Figure 2: Expert consensus conceptualization of "critical thinking"

The APA Delphi Research Project consumed two years and produced a robust and durable consensus conceptualization. It served the U.S. Department of Education (DOE) well in the Goals 2000 effort, an effort which attempted to identify those basic skills which should be expected for success in the workplace (NCES, 1993, & NCES, 1994). In 1993 and 1994, the Center for the Study of Higher Education at Pennsylvania State University undertook a study of 200 policy makers, employers, and faculty members from two-year and four-year colleges to determine what this group took to be the core critical thinking skills and habits of mind. That Pennsylvania State University study, under the direction of Dr. Elizabeth Jones, was funded by the U.S. Department of Education Office of Educational Research and Instruction. The Penn State study findings, published in 1995, confirmed the expert consensus expressed in the APA report (Jones et al., 1994, & Jones et al., 1995). We are grateful to the team at Penn State and to the DOE for their interest in following up Peter's work with a survey investigation that endorsed the findings, as it is not often that research results are tested quickly and directly in the social sciences. The findings of the APA Delphi Project Report continue to be cited by hundreds of books, reports, doctoral dissertations, and study commissions throughout the full array of disciplines and professions in the United States and abroad. Depending on the search terms entered, Google shows up to 2500 hits, with over about 900 citations in Google Scholar across an amazingly broad spectrum of disciplines and professional fields. Through the work of independent researchers who have applied this consensus definition to their own research and training efforts, today the APA Delphi Project Report serves as an international, multi-disciplinary, expert consensus conceptualization of critical thinking, a theoretical framework cited by researchers and educators throughout the world. The executive summary of the report can be downloaded at http://www.insightassessment.com/CT-Resources/Expert-Consensus-on-Critical-Thinking.

Some might say, "Critical thinking is the commons of higher education. It is everyone's domain, and so no one has to be solely responsible for its maintenance." We disagree. When the stakes are high (as they are with the education of our population, the effectiveness of our armed forces, the performance of our industries, and the services delivered by our key professionals--to name just a few), clarity in the description of this key educational outcome is not trivial. The APA Delphi Project consensus description, authored by many experts through the method pioneered by the RAND Corporation, endorsed by many sectors and now by many nations, offers better footing than home-cooked definitions about what local communities want to mean by critical thinking. By the mid-1990s it was past time to get by the definitional question and to address vigorously the challenges of demonstrating achievements in the training of thinking skills and the mindset needed to be a reliably strong critical thinker.

D. Does instruction in critical thinking actually result in measurably stronger skills?

During the years the APA Delphi Project consensus was coming together, the California State University System embraced critical thinking as a general education

requirement for its more than 400,000 undergraduates (Executive Order 338, 1980). The Philosophy Department faculties at Sonoma State, Sacramento State, Long Beach State, Fullerton State and other state colleges developed strong courses intended to develop students' critical thinking. So did other departments. At Fullerton, for example, courses in English, Economics, Reading, and Psychology were also approved as satisfying the critical thinking requirement, based on the stated intentions of their proposing departments. Here too, it became highly desirable to have a unifying conceptualization of critical thinking that was based on something more objective and credible than the say-so of any given department seeking enrollments.

The assessment movement was growing hand in hand with the critical thinking movement. In 1985, Peter had completed a project for the Senate of the State of California that predicted the emergence of educational assessment as a major factor in K-12 and higher education going forward (Facione, P. A., 1985). The merger of curricular requirements framed as learning outcomes and the assessment movement was conceptually and functionally inevitable. It was reasonable to ask whether or not students individually or as a group were achieving the learning objectives which the faculty of the institution had designated as essential requirements. How can we know how well our students are developing their critical thinking?

By 1989 the "assessment" had already become "the A-word" – evoking immediate disdain in any number of faculty office buildings. Many humanities faculty opined that critical thinking was too complex and ineffable to ever be measured. The Delphi Research Project definition was in final draft form, so we had a construct that was, in principle, capable of being measured. And faculty members throughout the California State University and nationwide were giving grades to students in critical thinking courses. So it followed that at least some of them believed that there was something there to measure!

More to the point, the original version of the California Critical Thinking Skills Test (CCTST) had been used in a number of validation samples. The instrument was constructed to provide three scale measures (Analysis, Inference, and Evaluation) in accord with the APA Delphi Project conceptualization of "critical thinking" and two scales responding to the more traditional dichotomy of Inductive Reasoning versus Deductive Reasoning. To Peter, questions about whether or not critical thinking skills could be measured objectively were straightforward empirical questions. The literature on the measurement of cognitive skills was very well developed. There was preliminary evidence that critical thinking skills could be measured with the CCTST. So, all that was needed was to design and then execute a full-scale, case-control study.

With approved critical thinking courses offered by several of its departments, California State University Fullerton offered a wonderful laboratory for a larger scale experimental study. Peter's colleagues in Philosophy and the other departments graciously agreed to permit the research to move forward. Remember, this was in 1990, when broad conversations about how one would bring critical thinking teaching and learning strategies to a lecture based classroom culture where just beginning. Some of the early adopters were using group projects, peer teaching, classroom debates, role-playing exercises, Socratic teaching, talk-aloud exercises, fish-bowl exercises, and other teaching tactics to engage students in the exercise of their critical thinking skills. The faculty teaching these courses agreed to permit Peter to measure their students' critical thinking skills before and after they completed the designated courses (these were the "cases"). In addition, these and many other generous colleagues, teaching other courses where they believed critical thinking skills were also being trained, agreed to allow their students to be tested (the first "control group"). Introduction to Philosophy courses figured strongly in this control group. A second, larger control group, were students who had taken courses throughout the college curriculum, but had not yet taken either an approved critical thinking course or a course, like Introduction to Philosophy, which the instructors believed also contributed to gains in critical thinking even if the course had not been approved by the campus as fulfilling the campus critical thinking requirement.

Pre-test and post-test data were gathered on thousands of students. In the approved critical thinking courses significant skills gains were seen, but not in either of the control groups. Peter's research design allowed him to rule out other variables as contributing to the observed gains (age and sex of the student, the number of units they had completed toward their degree, the part-time or full time status of the instructor, the textbook used, or the discipline of the professor). All the approved critical thinking courses showed significant gains, and the course that showed the largest gains was the Reading Department course (Facione, P. A., 1990a, 1990b, 1990c, 1990d). This finding that teaching for critical thinking required a deliberate and sustained focus on, and practice of, critical thinking skills, has been replicated many times, by many independent investigators, in many educational settings, including a meta-study of schools of nursing that were using the CCTST to assess the critical thinking component of diagnostic reasoning (Facione, N. C. , 1995). More on the findings from this meta-study later. First, irony abounds.

When the State of California mandated that its three huge higher education systems should have a unified set of general education requirements, the English department lobby of the University of California, with the support of their disciplinary colleagues in the California State University system and the California Community College system, successfully eliminated critical thinking as a separate learning outcome. The turf wars began in 1986 with the legislative mandate and ended in 1991 with a limited set of common general education breadth requirements known as the "Intersegmental General Education

Transfer Curriculum (IGETC)." The California IGETC remains in place today. The impact on critical thinking courses at California State University system institutions was predictably severe. No longer accepted as fulfilling a graduation requirement, most of the courses that had demonstrated their efficacy in training critical thinking in the CCTST validation studies withered for lack of enroll-ment. The writing faculty took over the job of teaching both effective writing and critical thinking.

A secondary effect of limiting critical thinking to writing as taught in English composition was to center critical thinking in the minds of students and other faculty on text-based communication with a humanities and letters focus. Critical thinking as manifested in business, health sciences, engineering, law, and other professional fields, or as manifested in the sciences and more quantitative disciplines, or in oral and iconographic communications, the arts and elsewhere tended over the years to slip into the background. Not by intention, of course. But as a pre-dictable consequence of almost zero funding in the state budget for elective courses, there was almost no enrollment demand at public universities for courses that do not fulfill some requirement. A result was the exclusion in California of other disciplines from offering critical thinking courses that would fulfill general education requirements.

We agree that essays can provide indirect evidence of critical thinking on the part of the author. But we maintain that writing effectiveness and critical thinking are distinct constructs. The tools to measure the one do not necessar-ily reveal the quality of the other. Whether the essays are machine graded or graded by humans, measurement tools which conflate these two constructs are generally less valid, less discriminatory, and less reliable because one cannot be sure if a lower rating is the result of the failure of the one set of skills or a failure of the other set of skills. This is particularly true of rubrics or rating forms if the same person assesses both outcomes as it has been clearly shown that the ratings will not be entirely independent. The mea-surement error in the second rating will be influenced by the heuristic process we call "anchoring with adjustment" (Epley, N. & Gilovich, T., 2001). For a bit more on four measurement challenges presented by rubrics when they are used for high stakes summative assessment, see Peter's post "CT Assessment Using Rubrics" to the AILACT-D discussion group June 10, 2013 or consult this webpage: http://www.insightassessment.com/FAQ/FAQs-General-Critical-Thinking/Can-critical-thinking-be-assessed-with-rubrics/(language)/eng-US.

In the 1990's, the vision we had for our scholarship was simply to bring valid and reliable measures of critical thinking to any instructor engaged in the work of building critical thinking skills and habits of mind. We had a limited understanding then of how the instruments would later be used. But within a few years, we learned that providing instrumentation for the measure of critical thinking would require an expanding instrument protection practices, and a state of the art technology team. We formed Measured Reasons to oversee and continue the instrument development work. And we formed Insight Assessment to provide the expert staff support needed to assist those who adopted the instrument and the technological support to maintain the secure and reliable online testing capability needed by those who use the tools. Our work with these companies and the contribution they make to assessment is described below in Section IV. B.

E. What is the relationship of critical thinking skills and the dispositional attributes described as important by the APA Delphi Project Report?

Perhaps the biggest "Oh my gosh! Why not?" occurred in 1991-92. Noreen was conducting research into the reasons why some women who discover a worrisome breast change delay three-months or more before seeking a diagnosis from a health care provider. Trained in the social and behavioral sciences and in the psychometrics of survey design at Stanford and UCSF, she was creating tools to measure the dispositional component of the decision to delay. In a remarkable and memorable conversation, she asked Peter why he had not sought yet to measure critical thinking dispositions in addition to skills. She even suspected that it would assist her in her own research if she were to include a measure of the subjects' disposition to engage their critical thinking skills as a method of addressing their worrisome symptomatology. From there the development and validation of the California Critical Thinking Disposition Inventory (CCTDI) was a straightforward application of known methods for measuring attitudes by accessing a person's beliefs, values, and intentions (Facione, N. C. et al., 1994 & Facione, P. A. et al., 2000).

Figure 3 presents seven constructs based on the APA Delphi Project description of the "Ideal Critical Thinker," and it is important to note that these seven constructs (Truthseeking, Open-mindedness, Analyticity, Systematicity, Confidence in Reasoning, Inquisitiveness, and Maturity of Judgment) are empirically derived (Facione, P. A. et al 1995, & Facione, N. C. et al. 1994). This means that the seven mindset attributes captured in the CCTDI were unknown at the start of the study, emerging through the use of survey and factor analytic methods. The strong validity and reliability of the CCTDI was originally validated in an international English-speaking sample in the USA and Canada. Although many independent research studies have used an early variable (overall score) that is simply the sum of the seven scale scores, in fact these scales are independent measures, and each is important. An individual can be strong in some areas and quite weak in others. The use of the overall score is now discouraged because the overall score has the potential to mask one or more significant areas of concern in the critical thinking mindset. For example, one might not want to interview a job candidate who had high scores for Analyticity, Inquisi-

tiveness, and Maturity of Judgment, but a low score for Truthseeking and a very low score for Open-mindedness. (See the CCTDI Test Manual from Insight Assessment for further specifics.)

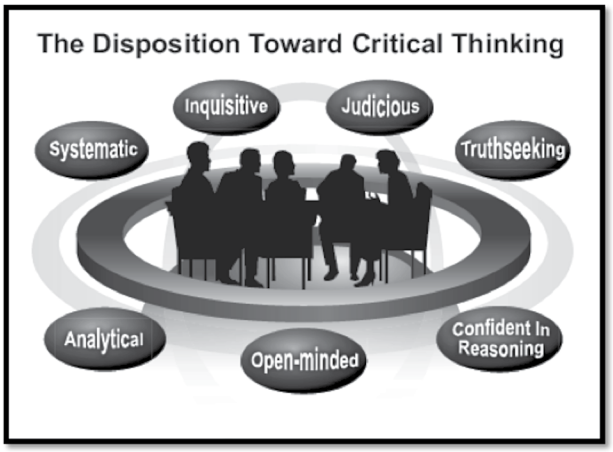


Figure 3: Seven Critical thinking dispositional attributes reported on the CCTDI

Initially, it was not known whether the CCTDI attributes would be embraced as relevant by educators or be valued by other cultures, but in the more than 20 years since the instrument was created, the CCTDI has been widely used by educators in the humanities and in many professional fields, and it has been the subject of scores of translation and validation projects with collaborative scholars around the world (Facione, P. A. et al., 2009, & Facione, P. A. et al., 1999). Today it is available in Arabic, Beijing Chinese Simplified, Hong Kong Chinese Tradition-al, Taiwanese Chinese Traditional, Dutch, English, Farsi, Finnish, French, German, Hebrew, Bahasa Indonesian, Italian, Japanese, Korean, Portuguese, Spanish, Thai, and Turkish, and, as a result, a growing international literature is evolving in the area of critical thinking disposition/ mindset. This is only possible because of the generous and skilled contribution of collaborating scholars who assure the cultural relevance of items and carry out the validation studies that are needed to demonstrate the instruments' validity and reliability. We celebrate all of our translation partners on this website link: http://www.insightassess-ment.com/Services/The-International-Measurement-of-Critical-Thinking/Authorized-Translations/node_2859 .

The APA Delphi Project panel experts believed that strong critical thinking skills and a positive disposition to engage those skills always went hand in hand (would be highly correlated). But early empirical findings emerged to show that some individuals are highly disposed toward critical thinking but lack strong critical thinking skills, others are highly skilled but not disposed to use those skills, a third group are both disposed and skilled, and a fourth group are people whose skills are poor and who are essentially hostile to the attributes associated with critical thinking. The APA Delphi Project experts were clear in their belief that both skills and mindset were important, and we absolutely agree. One must be both willing (disposed) and able (skilled) to consistently engage high stakes issues and problems if the result is to be good critical thinking about what to believe and what to on a regular basis. This means that when teaching critical thinking one must do more than exercise the skills, one must also cultivate the consistent internal motivation in students to engage problems and to make decisions using those critical thinking skills. It also means that one can desire to think well but unless one also possesses the thinking skills needed, the desire will be unfulfilled.

In one of the earliest studies of the impact of a four year undergraduate experience on critical thinking disposition, Peter and a colleague, Dr. Carol Giancarlo (Gittens) carried out a longitudinal study examining critical thinking dispositions in students at Santa Clara University in the late 1990's (Giancarlo, C. & Facione, P., 2001). Pretest assessments using the CCTDI were gathered during a student orientation session when freshmen first arrived on campus. One attribute measured by the CCTDI (Truthseeking), the habit of always desiring the best possible understanding of any given situation. Truthseeking requires following reasons and evidence where ever they may lead, even if they lead one to question cherished beliefs. Truthseeking can be quite low in the freshman student population, even at selective universities. Following reasons and evidence wherever they lead in the quest for best knowledge is not a well-established habit of mind in many 18 and 19 year-olds. In Figure 4, the distribution of the students' post-test scores in Truthseeking is represented by the gray area, while the dotted line traces the distribution of the Truthseeking scores for the pre-test in this same sample. These gains in truthseeking are something for the faculty at Santa Clara to celebrate, as truthseeking is difficult for all of us, requiring that we abandon biases and preconceptions. After more than a decade of additional CCTDI data collection at universities around the US and internationally, we now know that Santa Clara's distribution of scores in Truthseeking was relatively strong in their pre-test undergraduate admissions sample, and that their students demonstrated significant growth in this attribute by their post-test scores.

Moving a distribution curve in a positive direction like this is the goal in the achievement of learning outcomes. There are three qualitative ranges shown in the graphic: a negative mindset rejecting truthseeking (left side of the graphic), a positive mindset embracing truthseeking (right side of the graphic) and the inconsistent, ambivalent endorsement of truthseeking (the area between the vertical bars. The attributes we associate with strength in critical thinking are typically stable, but change has been documented over time, particularly in the young adult population. The change can be both positive and negative. In this sample the change in Truthseeking is largely positive. Many students moved to at least the ambivalent endorsement of truthseeking, and others moved all the

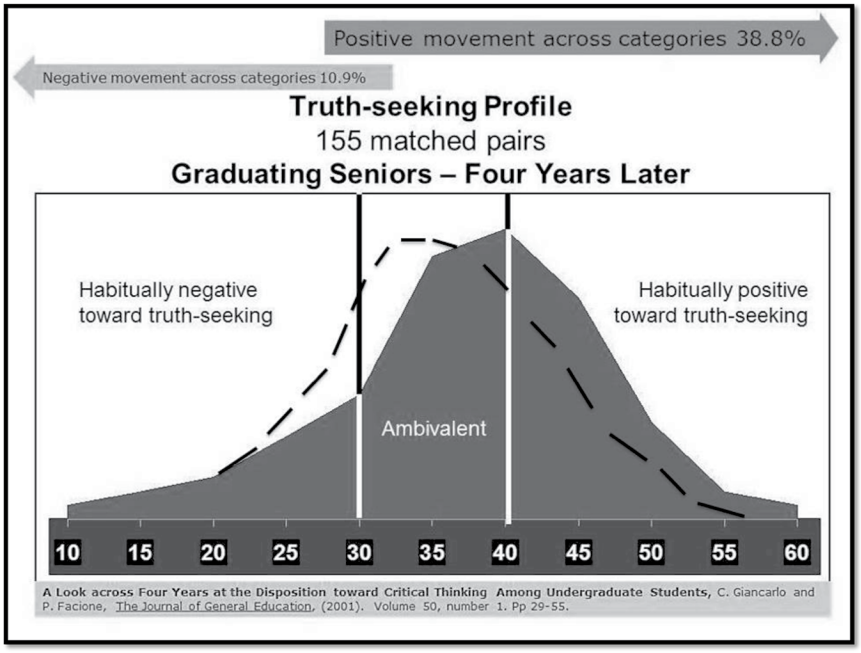


Figure 4. Gains in Truthseeking at the end of a four year college experience.

way to a consistent positive mindset for truthseeking (60 students, 38.8%).

But not every student became more of a truthseeker, as 16 students (10.9%) moved to embracing truthseeking more ambivalently or becoming more hostile to the truth-seeking mindset at post-test. These students were perhaps threatened or made uncertain by the challenge of faculty and peers to examine all emerging information and others' points of view. This research finding was the first of many to document the maturation of the college student population as a result of effective liberal education.

F. Can one improve critical thinking skills and strengthen the disposition to apply those skills?

The answer is unequivocally yes! There is a vast independent literature demonstrating this using tools we developed. This literature documents an array of useful teaching and learning strategies that allow an instructor to see and hear the growth of skills and mindset in the vocalizations, presentations, writings, case presentations, demonstrations, and professional practices of the students and trainees. We collected some of the best strategies in an annotated collection showcasing health science educators (Facione, N. C. & Facione, P. A., 2008). These examples readily suggest how the strategies may be adapted to any discipline or training program, and in each case there is an emphasis on how one might build in a classroom level assessment of the learning outcomes resulting from the training methods. Other studies are listed at http://www.insightassessment.com/CT-Resources/Independent-Critical-Thinking-Research.

In the early 1990's, the National League for Nursing, nursing's professional accrediting body called for objective assessment of learning outcomes and specifically for the assessment of critical thinking (Facione, P. A. & Facione, N. C., 1995). By 1996, sufficient data had been collected to permit a meta-study of critical thinking in nursing education. Using the data from 50 schools of nursing, largely in the USA, in collaboration with faculty at each individual nursing education program, the collective findings were of great interest. This study documented gains in critical thinking skills and dispositions as a result of many of the nursing program courses. This study documented that male and female nurses had equally strong critical thinking skills. This was an old finding in many other samples, putting to rest the question of whether there was a gender difference in this ability and reconfirming the lack of gender bias in the CCTST instrument. But males were new to nursing in the 1990's, and they were transforming the culture of the nursing classroom, asserting their position in the group. It was informative to learn that in this key skills area, important for clinical decision-making, males being admitted to nursing programs were neither a selective ability cohort nor a group that would be particularly challenged by the professional demands.

One of the unexpected things that we learned as a result of this study was that the mere discussion by faculty of how one might better train critical thinking skills was associated with significantly improved scores on the CCTST. Figure 5 summarizes the results of this surprising study. The x-axis values ranging from 10 to 22 represent the magnitude of the mean score for the variable Overall which is the holistic measure of critical thinking skills reported by the CCTST. These means for Overall were calculated for the aggregated sample of students in the 50 participating nurse preparation programs. Faculty in the programs reported on each study variable listed on the y-axis: Had the faculty designated a specific *CT focus* in the curriculum? Was *CT being discussed by the faculty*? Was there a *curriculum plan* to incorporate critical thinking into the curriculum? Was there *a designated CT course*? Had the program *analyzed their CT data* to learn about their students' performance?

In each case, in programs where the answer to each question was "Yes," we observed the aggregated mean to be statistically significantly higher for critical thinking skills measured by the variable "Overall." While participants might have expected to see higher scores in critical thinking when curriculum change was already well established, how to explain higher scores for less established

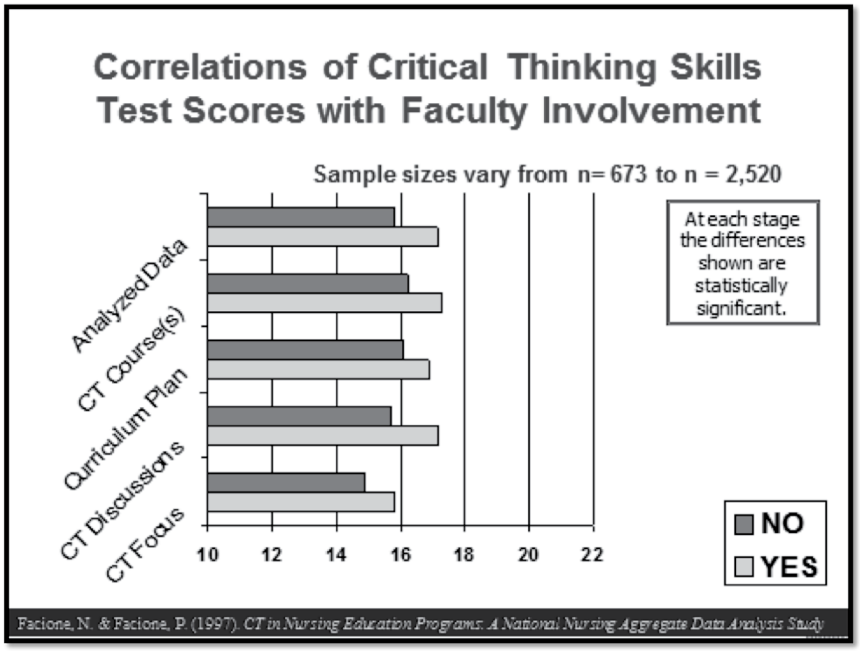


Figure 5: Faculty activities and student critical thinking skills scores

curriculum change? We were already aware of the threat to validity involved with trying to separate learners and examine critical thinking skills on the same campus (cases and controls) because of enthusiasm about the teaching intervention being tested. Now came not-too-surprising (but welcome) news that the very discussion of critical thinking might be affecting student scores presumably because faculty were already making adjustments to their standing courses in advance of curriculum revisions, and achieving some of the gains that would later come with the complete curriculum revision. This is important information for those who plan controlled experiments to measure the effects of a teaching and learning intervention (Facione, N. C. & Facione, P. A., 1997).

Another unexpected finding from the Nursing Education study was that returning adult learners who were practicing registered nurses who were completing their Bachelor's degrees were often regressing in their critical thinking dispositions when comparing pretest (at or near the beginning of the program) to post test (at or near completion of the program). This was surprising, given that professional development programs value all of the CCTDI constructs. Our collaborating nurse educators hypothesized that these registered nurses may have been reacting to the demand that they conform to the undergraduate classroom environment and to the lack of understanding at that time as to how to integrate the adult learner into existing generic undergraduate cohorts. The result in many cases was a renewed effort to create more appropriate expectations and course requirements for them as adult learners.

G. How well should a group of college level learners perform on a measure of critical thinking skills?

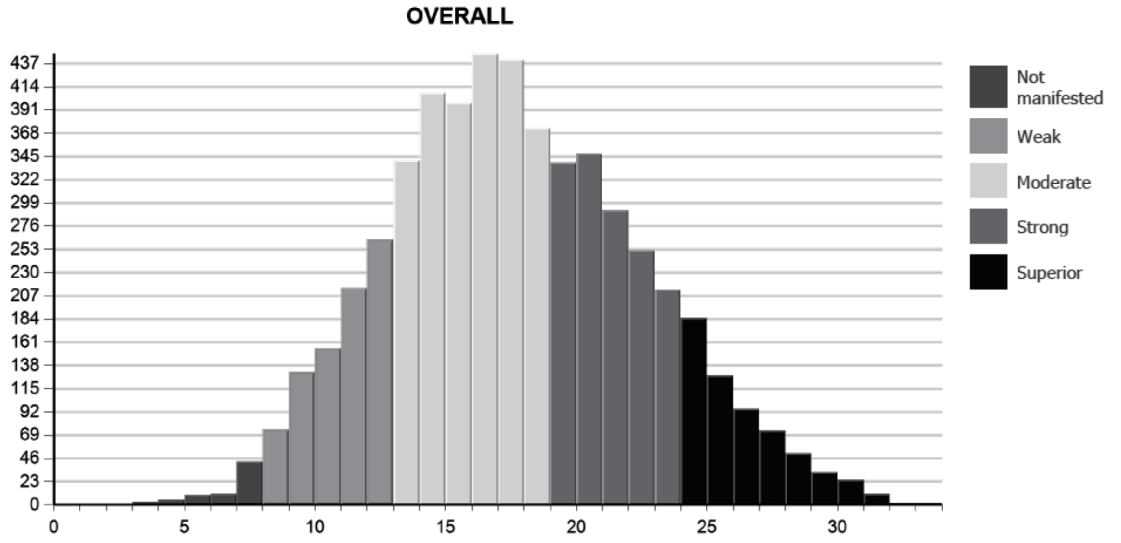
While it may be reasonable to expect that students and professional level employees will universally demonstrate strength in critical thinking skills, in any given sample of these individuals there will be a distribution of Overall scores on the CCTST that range across a wide continuum of strength in critical thinking. Some undergraduate students will be well prepared for college level learning, entering programs with superior or strong reasoning skills. Others will have adequate skills, but will succeed in reaching their educational goals only if they improve their reasoning skills during the course of the program. Hence the importance of focusing on training reasoning skills as a component of undergraduate education. Graduate level students and employees are more likely to be offered program admission or employment after demonstrating strength in critical thinking. But when they are admitted to programs and lack these skills, they are likely fail to complete professional training programs, fail to pass licensure examinations, and transition poorly to professional jobs.

Depending on how grades were assigned, even students with strong secondary school GPA's can have poor critical thinking skills. There are fewer examples of this in US samples than in those from other part of the world where critical thinking pedagogies are less common and higher grades are given for memorizing large blocks of relatively unexamined content. Even so, in most undergraduate samples, and some graduate samples, students are seen with critical thinking scores below the US high school mean score. Poor critical thinking skills at college entry are predictive of the inability to connect with college level coursework or to benefit from planned educational programs. Students with low critical thinking scores are at risk and likely to leave the university before graduation if their deficits in critical thinking are not addressed.

Figure 6 is an aggregated sample of individuals (N=5369) that is characteristic of the bell shaped curve that will be seen in a typical university sample. The selectivity of the institution's admissions criteria will be one factor determining the midpoint and the range of scores seen in the sample, but the CCTST's calibration to the undergraduate level student nationally allows even very selective institutions to compare their students to the national norm group. The ability to offer interpretations of scores as Superior, Strong, Moderate, Weak, or Not Manifested rests on decades of research both internal and

Descriptive Information: OVERALL

N	Mean	Median	Standard Deviation	SE Mean	Minimum	Maximum	Quartile 1	Quartile 3
5369	17.2	17.0	4.9	0.1	3	33	14.0	21.0



independent associating Overall score levels with subsequent performance indicators such as certification and licensure examinations, workplace performance indicators, demonstration of mastery in training programs, supervisor evaluations, and other criterion measures. A selection of these studies are referenced here (Tiwari, A., Lai, P., So, M., & Yuen K., (2006); Williams, K. B., Schmidt, C., Tilliss, T. S., Wilkins, K., & Glasnapp, D. R. (2006); Wangensteen, S., Johansson, I. S., Bjorkstrom, M. E., & Nordstrom, G. (2011); Vendrely, A. (2007); McCall, K. L., MacLaughlin, E. J., Fike, D. S., & Ruiz, B. (2007); Huang, Y. C., Chen, H. H., Yeh, M. L., & Chung, Y. C. (2012); Colt, D. E. (2007); Butchart, S., et al. (2009); Barak, M., Ben-Chaim, D., & Zoller, U. (2006); Albert, R. T., Albert, R. E., & Radsma, J. (2002); Allen, D. D., & Bond, C. A. (2001); Godzyk, K. E., (2008); Kwon, N., Onwuegbuzie A. J., & Alexander, L. (2007)).

H. How do people make important decisions when they have the time to think them through?

Just as the APA in the 1970's treated research on teaching and measuring critical thinking as less relevant to the discipline of Philosophy, the health science professions saw this research as peripheral to mainline science in the health professions. None the less, UCSF was supportive of Noreen's work, then dominated by questions which had thinking and decision-making as a component. She worked collaboratively with health science researchers across the specialties, adding considerations involving health related decisions to broader health studies. How did one decide to donate a kidney (Painter, T. et al., 2006)? How did people decide that they would be faithful to their treatment plans and medication schedules (Wong, et al., 2006)? What was the impact on health care utilization of a person deciding that they would experience prejudice in a health care setting (Facione, N. C. & Facione, P. A., 2007)?

Noreen's health science research was important in itself, but also the fertile ground for our continued collaborative work in the development of an argument analysis methodology. Both of us knew that in spite of interest in developing techniques of concept mapping and the development of software that assisted the recording of brainstorming sessions, there was no current methodology for fully analyzing a decision process. There was no method that offered the possibility of capturing a picture of the wandering, sometimes illogical and fragmented, often iterative and non-sequential, processing that occurs when a decision process is described. Using talk-aloud-data about high stakes decisions and a process of argument and heuristic analysis, we were evolving at the time to analyze real narratives about health-related decisions, we were able to see that a decision to donate a kidney looked something like this (Figure 7):

To learn something important about how this individual made a decision to donate a kidney, one need only know what the shapes refer to in the graphic. The six diamonds represent the key considerations that the decision maker raised as relevant to the decision. We call these "watershed ideas" because they deserve to be carefully considered. They are ideas or issues that, depending on how they are analyzed and interpreted, might incline one toward one outcome or another. The circles represent 18 argument strands this individual made either in response to one of the watershed ideas or independent of them. All 18 argu-

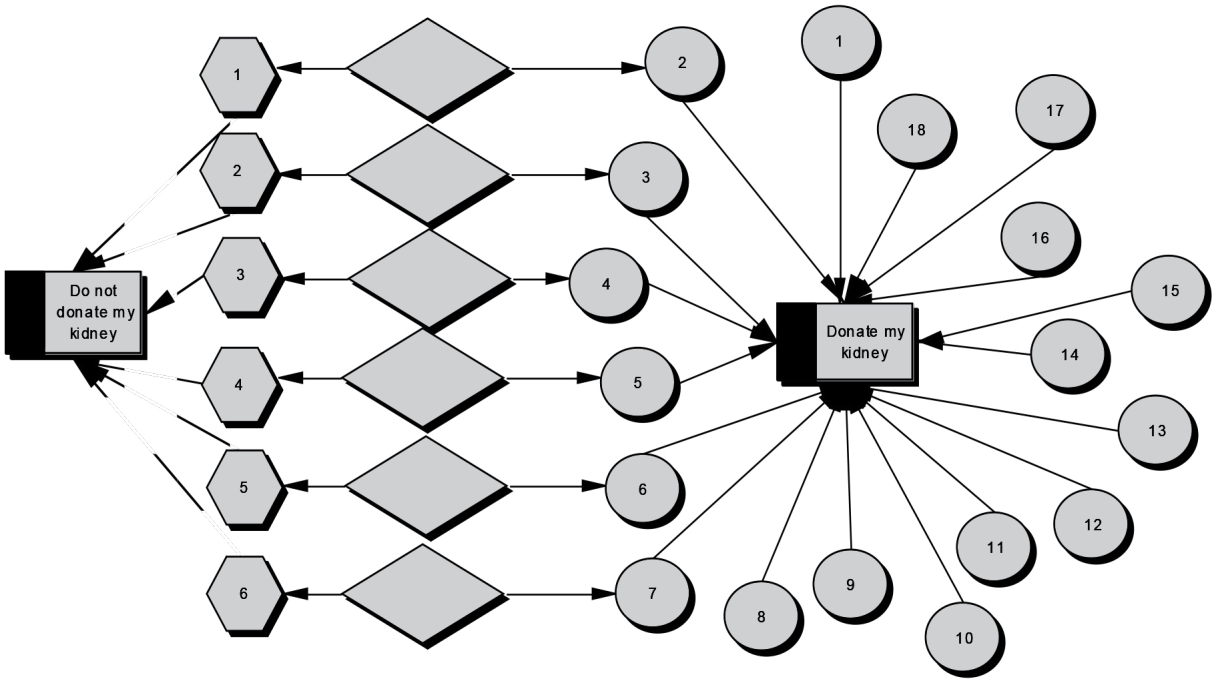


Figure 7: The structure of one person's decision to donate a kidney.

ments support donating the kidney (my cousin needs my kidney, I'm the best match, etc.). The six hexagons ("stop signs") indicate a partially developed argument made in consideration of not donating a kidney (the surgical danger, the pain, etc.). In this case all argument strands moving toward not donating were abandoned. None even resulted in an explicit claim, "Perhaps it is a bad idea to donate."

The clustering of many arguments around one option and the underdevelopment or abandonment of argument strands that would support another option is a powerful visual representation of Montgomery's claim that all high stakes decisions are the result of "dominance structuring" (Montgomery, 1989). He described this process of creating numerous bolstering arguments to support the expected and preferred decision (in this case, to donate the kidney). Although some high stakes decisions will contain numerous full-fledged arguments for each option, in our experience, even those decisions that humans experience as well-considered and fair-minded often have this clearly lopsided structure, favoring only one option and defending against arguments for the option that is not preferred. A strongly positive critical thinking mindset would impel us to reflect more fully on considerations leading toward all reasonable options, rather than simply to bolster unreflectively our preferred choice. Teaching metacognitive reflection at the moment of decision-making and problem solving is the key to developing strong critical thinking and to making good decisions about what to believe or what to do.

Our work in this area led to two publishing projects, one of which was the publication, mentioned above, in 2008 of *Critical Thinking and Clinical Reasoning: An International Multidisciplinary Teaching Anthology* (Facione, N. C. & Facione, P. A., 2008). The other project was the 2007 book that integrated all of our research conducted through the years on how best to analyze high stakes decisions. *Thinking and Reasoning in Human Decision Making: The Method of Argument and Heuristic Analysis* (Facione, P. A. & Facione, N. C., 2007).

We developed the method for mapping decisions and arguments analysis using real narratives with research subjects describing their thinking process as they tackled extremely high stakes dilemmas in their lives. The interviews were designed to elicit thinking process, not just the resulting judgment, so the argument mapping demanded more sophisticated maneuvers than the techniques we found others using. Examples are "Talk with me about how you made the decision to turn down that promotion?" and "How did you ever decide to donate your kidney?" One example of the method that we included in the book maps the published account of Governor Arnold Schwarzenegger's argument for not commuting the death sentence of Stanley "Tookie" Williams. This example is intended to demonstrate how published accounts of decision processes can also be mapped, examined and evaluated.

Thinking and Reasoning in Human Decision Making is the book one writes later in one's career that synthesizes and refines most of what one has learned over many decades. Figure 8 below, for example, is a conceptualization that models the relationship between System-2 reflective decision making (critical thinking) relates to our more reactive, associational, and holistic decision-making, System-1. For those who would like more on the System 1 and 2 theory, there are many excellent papers, but we would point you to one by Salomon (2002), in an excellent

collection of papers (Gilovich, T., Griffin, D., & Kahneman, D. 2002).

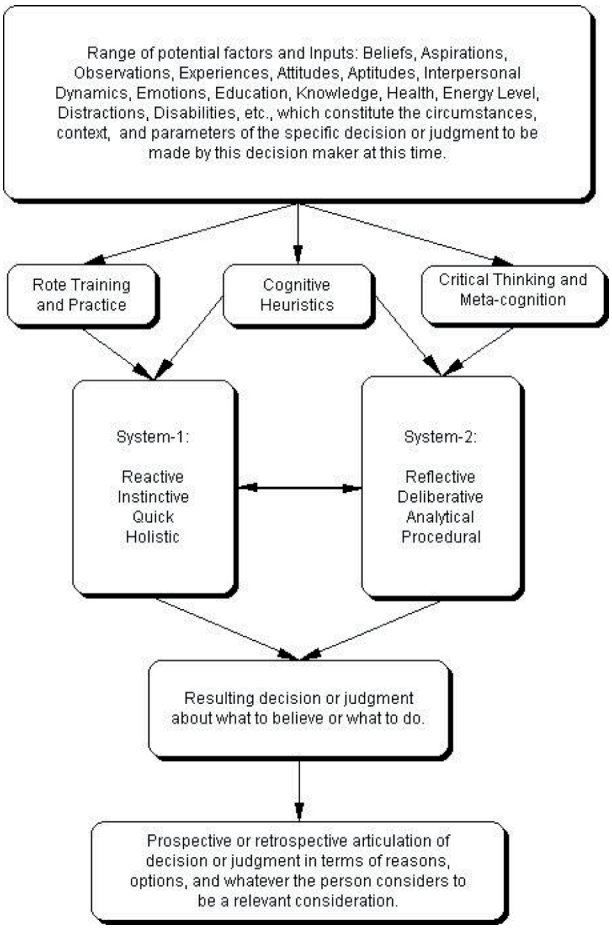


Figure 8: Facione and Facione model of reflective and reactive naturalistic decision making processes, from *Thinking and Reasoning in Human Decision Making*

IV. Practical Questions We Are Often Asked

A. How do you get all this into the classroom?

To bring all this research into the classroom, and in keeping with the practical focus of all of our work, Peter collaborated with Carol Gittens to produce *THINK Critically*, which was published in a second edition by Pearson Education in 2013 (Facione & Gittens, 2013). In addition to the standard topics, such as inductive reasoning, deductive reasoning, and fallacies found in all such books, this text includes chapters on critical thinking in the natural sciences, critical thinking in the social sciences, problem solving and college success, critical thinking and ethical decision making, snap judgments and heuristic thinking, strategies for argument mapping and for making reflective judgments. Peter says that his favorite chapters, however, are the three at the end which round out the picture of human argument making. These three reveal the powerfully divergent methodologies that impact our decision-making and often result in misunderstanding and strife over what should be believed or done. The three chapters are those that analyze, explain, compare and contrast three types of reasoning: empirical, analogical and ideological.

B. Why did you form Insight Assessment and Measured Reasons?

It was work in the area of metacognitive reflection at the moment of decision-making and problem solving, and the on-going work with our instrument development team, that eventually convinced us that we needed to exit our higher education careers where we were serving in roles which included university director of faculty development (Noreen) and university provost (Peter). In 2004 we left academia for a more independent workplace where we could continue our instrument development and research through Measured Reasons as well as support the work being done by our staff at Insight Assessment. Like many entrepreneurs and independent consultants, we are working about 300% time and have been enjoying the opportunity to structure projects more effectively. Our instrument development team at Measured Reasons has expanded to include the valued talents of other scholars and experts. We are most appreciative of the contributions of Dr. Carol Gittens, specialist in college level assessment, program evaluation consultant, and current Associate Dean of Arts and Sciences at Santa Clara University, and of the instrument development and validation work done by Mr. Mark Winterhalter, former Chief Information Officer at Borders International, current Chief of Operations at Insight Assessment, and independent consultant to the business community. Over the past decade, Peter has divided his time between leading the instrument development team, C-suite consulting, providing training workshops in high stakes reasoning for the military and other institutions, and of course writing (more than could be written while he was in academic administration). Noreen has been leading Insight Assessment as it has grown into an international assessment company providing psychometric consultation for clients and ongoing instrument development, and completing writing projects that were not getting enough attention while she was in academic administration.

Providing clients with the information they need to select an appropriate instrument for their project, and delivering real-time individual assessment reports, group statistical summaries, and presentation-ready graphics requires the support of an educated staff and resources. Today, people are accustomed to receiving information when they need it and not a moment later. Supporting high stakes assessment requires protected test items and measurement tools that can be delivered worldwide by a secure, encrypted technological system, in multiple languages, forms, versions, and modalities, and it requires a successful business model. In 2007 we were faced with the need to grow the technology capability of the company

to expand our online testing capability in order to sustain the increasing demands for user friendly, secure, online delivery of our instruments to an enlarging customer base. Fortunately at that time we were privileged to be joined by two technology leaders, Mark Winterhalter and Bruce Kohler, who had led other international companies to successful and innovative business models. They shared our vision for the company, understanding the value of bringing the assessment of reasoning skills and mindset to our then emerging international market. Through their leadership, Insight Assessment's technology staff maintains state of the art database protection and online delivery of its assessment products.

Today the assessment instruments we have authored based on the APA Delphi Project conceptualization of critical thinking are used by educational, medical, military, legal and business organizations in all 50 states and in over 60 countries worldwide. Our critical thinking skills test item bank has been continually expanded and refined for more than forty years to address the needs of the various instruments it supports. Now the critical thinking skills tests are available in multiple forms, versions, and language variants for use within and across multiple professional fields and educational levels from third grade to the doctoral level. In the case of each of our current critical thinking skills instruments, the overall numerical score is accompanied by national percentile norms for a variety of test populations as well as a qualitative indicator suggesting where that score falls in broad ranges between "not manifested" and "superior." The associated sub-scale measures function as useful indicators for educators and trainers to assist with curriculum revision in particular skill areas. We have expanded the scale offerings for several of the online versions to include "Interpretation" and "Explanation."

Over the years we came to realize that supporting a wide variety of projects at different educational levels and in different professional fields called for the development of a fairly large array of measurement tools along with the infrastructure to support their proper scoring and use. In addition to maintaining the quality of the existing instrument group, we pressed forward with the development of additional instruments needed to serve specific sectors of our global society. Today there are more than 140 instruments in this family of measures, nearly all aimed at capturing measurements of critical thinking skills and related personal attributes associated with the critical thinking mindset. Some of these we refer to as the INSIGHT series of skills and mindset measures for business and professional uses. Some are designed in collaboration with Dr. Gittens for K-12 (the CM3, the LSRP, and the CCTST-M series). And some, also designed in collaboration with Dr. Gittens, incorporate a measure of numeracy skills (the Numeracy series of the CCTST-N, CCTST M-Series, BCTST-N, TER-N, and HSRT-N). We are using the acronyms here, but further information is available on this website: www.insightassessment.com. Insight Assessment is the company we formed to offer assessment services.

Through the dedicated work of our staff at Insight Assessment, adoption and use of the instruments has expanded to include support for admissions screening in selective educational programs, tools for studying student retention, measures of the effectiveness of specific teaching and learning techniques, and the tools of choice for Business and Health Science professional programs when the outcome being measured is high stakes reasoning. Over time our instruments have been approved by States and Countries as assessment tools for demonstrating the achievement of learning outcomes in performance-based funding environments. One unexpected opportunity that has come our way is the ability to provide valid and reliable instruments to dissertation scholars and senior researchers exploring a vast array of research questions touching on human reasoning skills and mindset. In the past twenty years, Insight Assessment's internal grant program has provided funding support for the use of our instruments to more than 250 international dissertation students across all disciplines. The psychometric strength of the measures we have designed are now well acknowledged internationally by scientific review committees as the "gold standard" for scientific investigations.

More recently there is an increasing interest by business, industry, and government to add the assessment of reasoning skills and mindset to the hiring and employee development process. Our new instrument series (INSIGHT) provides measures of reasoning skills and employee mindset for all levels of an organization, tailored to each group according to their expected decision responsibility. Realizing that employees engage more successfully in assessments that feel well fit to their jobs, there are specific versions of INSIGHT for the business community (INSIGHT Business), health service providers (INSIGHT Health) and legal services (INSIGHT Law). Each instrument provides metrics assessing of the mindset of the employee and the reasoning skills, both now valued as important for assuring an optimal decision process by individuals and groups in the workplace.

C. How are critical thinking skills and numeracy related and does one predict the other?

Numeracy is a construct gaining considerable interest in Australia and several other parts of the world. It can be thought of as the ability to solve quantitative reasoning problems and to make well-reasoned judgments derived from quantitative information in a variety of contexts. More than being able to compute or calculate a solution to a mathematical equation, numeracy includes understanding how quantitative information is gathered, represented, and correctly interpreted using graphs, charts, tables and diagrams. Leading scholars and educators have consistently argued that numeracy rivals reading literacy and language

fluency in its importance for learning and for life, an argument we support wholeheartedly.

In recent years we have had an increasing number of STEM faculty colleagues and other physical and natural science researchers ask the question: "How are critical thinking skills and numeracy related? and "Does one predict the other?" We think that although one might offer opinions about this question, well-developed empirical studies of the issue would be better. We also think that potentially much might be learned in this area that would be beneficial to mathematics and science education. Led by our colleague Dr. Carol Gittens, we have developed additional forms of our instrument array, linking them with measures of numeracy to assist those who would continue to explore this question more directly. (A discussion of numeracy can be found on this link: http://www.insightassessment.com/CT-Resources/Independent-Critical-Thinking-Research/pdf-file/z.embedded-content/Measuring-Quantitative-Reasoning-Numeracy/(language)/eng-US.)

D. How can we improve reflective decision making in risky, uncertain, and time-limited contexts?

In part we addressed this above when talking about the Bowling Green State University course redesign, the pedagogies used in the CSU Fullerton critical thinking courses, and the publication of the anthology of successful teaching strategies. People engage critical thinking when they need to (although not always), and when they realize that being thoughtful and truth-seeking are essential to making a good decision or to solving the problem at hand. So, in the end, the payoff for learning to think well needs to be practical. If well-reasoned problem solving and decision making can improve our personal, social, professional and civic lives, then great! Let's get good at it. But if it is of no practical value, then that's another story.

It is easy and yet essential to make the case to students for the value of critical thinking. We do it in our books, articles, workshops and even on our YouTube video. (The video can be viewed at http://www.youtube.com/watch?v=gT5S8pfGYq0 .) As business leaders, parents and grandparents, volunteer coaches, friends and neighbors we encourage people to become more informed, reflective, and fair-minded in their decision making and problem solving. And, of course, we are certainly not alone in promoting and encouraging critical thinking. In the end, strong critical thinking by well-informed ethical people is what everyone wants, particularly professionals like military, health care, business, and educators.

Our primary way of supporting the improvement of reasoning is through our business, Insight Assessment. We strive to assist our clients with solutions that enable them to evaluate reasoning skills and habits of mind. Whether they are using our instruments as part of the evaluation of employment applications or admissions applications, or to assess the effectiveness of a curricular program, or to gather data for diagnostic and training purposes, or to demonstrate institutional educational effectiveness, or in a peer reviewed scientific investigation, Insight Assessment provides high quality, secure, cost-effective assessment solutions. They are cost effective, but not cost free. This type of tool and its delivery is a complicated business, one that currently has support personnel and information systems and storage, in both the USA and Canada. But not every project requires the administration of protected instrumentation, and Insight Assessment also provides its clients with many free resources to support their efforts at training and assessing critical thinking.

E. What can be done when the assessment reveals significant weaknesses in critical thinking?

Obviously the answer is to seek effective training in critical thinking, as it is not a reasonable expectation that strength in reasoning should come without effort. Particularly for those who must self-teach, our best suggestion is the text authored by Peter and Carol Gittens mentioned above, because it is filled with engaging contemporary thinking exercises that are based on the state of the science in the training of human reasoning skills and the nurturing of the critical thinking mindset. Insight Assessment's testing clients are provided a classroom level package of teaching and learning support materials for trainers/teachers as well as trainees/students. Everyone is free to come to the Insight Assessment website and review or download a long list of resources (essays, rubrics, and other materials) for teaching and learning posted there www.insightassessment.com. These resources are part of our response to the question of how can we best support and sustain high quality, high stakes assessment and development of critical thinking.

F. Why do you have reservations about rubrics?

Since we designed the *Holistic Critical Thinking Scoring Rubric* and offer it as a free download, people wonder why we are concerned that it should be used appropriately. Well-designed rubrics and rating forms help raters to clarify performance expectations and to internalize the desired outcomes. Developmentally, rubrics and rating forms can assist instructors to identify gaps in educational programs. But rubrics and rating forms are highly subjective. The very aspect that makes them applicable to local uses are the same features which limit or eliminate their value for criterion based assessments or for cross-sample comparisons. The ratings people assign using rubrics are rarely objectively defendable as valid measures or, in some cases, even reliable. In today's higher education assessment movement, even well-designed rubrics are used in ways that have inherently high risks of invalidity and unreliability. Most assessment programs have not adopted the necessary rigor of training the raters and assessing their quality over time. Assessing the validity and reliability of ratings provided by raters using rubrics can be done with a high level of integrity, but it requires the collection of

rating data developed using standardized examples known to have well-established qualities (validity in the construct being rated), and a statistical test of the variance of the ratings across the raters and over time. A statistical test, known as the Kappa statistic, is used to determine if the ratings are stable enough to be reliable, that is that they do not vary in a statistically significant way over time or across raters. There is also an unfortunate practice of allowing the participation of raters who have vested interests in the outcome of the ratings, having themselves been the faculty involved in the educational program or training sessions. And, finally, rubrics which people (and machines) can apply well typically differentiate the items being rated into only three to five categories. That can be helpful developmentally, but it does not provide the sensitivity, spread of scores, and variance needed for more rigorous statistical analyses and summative assessments, particularly in high stakes settings which demand more precise and accurate measurement.

G. How can we best communicate about critical thinking with people who are not familiar with the jargon of the academy?

Considering all the baggage that the adjective "critical" carries in contexts where it means "negative" instead of "important," we have often thought that critical thinking was just too important to be called "critical thinking." And we wish we had a dime for every conversation we have had where people work overtime to sort out proposed distinctions and boundaries between critical thinking, clinical reasoning, professional judgment, strategic problem solving, problem framing, convergent thinking, divergent thinking, design thinking, and on and on and on. Energy spent palavering about thinking, rather than working on how to think better. In the end we have often found it more effective to talk about the skills and the mindset related to reflective, fair-minded problem solving and decision-making as contrasted with the heuristically driven snap judgments that are more reactive and associational. Lots of words, yes. But, in contrast to sorting out what "critical thinking" means, all of them are more readily understood in multiple contexts by people across a broad spectrum of professional, educational and life experiences.

McGraw Hill said "No" to the *Logic and Critical Thinking* title in 1978. Pearson demanded *THINK Critically* as a title for the first and second editions in 2011 and 2013. Who is right? Who knows? We might have been better entitling both books *How to Think Well*. For the sake of those we serve, we all need to communicate in a language that is as universally understandable as possible, avoiding at all costs esoteric, specialized or personalized definitions of common thinking words. We need to escape the interminable tyranny of terminological flawlessness and abandon the impractical Platonic snipe-hunt for definitional perfection. As the warden in *Cool Hand Luke* said, "What we have here is a failure to communicate."

H. Isn't it great that American business has become concerned about critical thinking?

Yes. Many senior business leaders recognize the importance of strong critical thinking skills and strong critical habits of mind for executives, professionals, and, in fact, every staff member tasked with solving problems and making decisions. We have seen more and more businesses using our testing tools to screen job applicants and to identify staff training opportunities. But, frankly, we do worry lest "critical thinking" should become just a buzz word, or that training these skills and nurturing these dispositions come to be seen as outcomes of a half-day workshop. Using strong critical thinking to work though novel and unexpected business problems and difficult decisions requires sustained focus and the investment of cognitive energy. We have encountered some who are put off by the negativity they associate with the word "critical." And there will always be those who feel more certainty when they make snap judgments, or when they trust their "gut," their "intuition," or their "experience." We understand the power of thinking heuristics and System-1 decision making. But there are times in business when there is just no reasonable substitute for the slower, more deliberative, more collaborative process of critical thinking.

I. Will critical thinking become irrelevant?

No. Regardless of what we call it, there will always be plenty of important work inside and outside of academia for those who teach the skills and nurture the positive habits of mind that enable people to engage in the process of purposeful, fair-minded reflective judgment about problems and issues of genuine concern.

J. Is it really true, as you suggested earlier, that everyone wants students and employees who are willing and able to engage problems and make decisions using critical thinking?

Well, to be fair, no, it is not. There are ideological extremists, both political and religious, in the US and elsewhere, who would sooner ban books, demonize intellectuals, marginalize disagreeable scientific findings, and in the worst cases burn schools, and, tragically, even kill children and their teachers, rather than permit women and men to be equipped with the skills and the mindset to raise tough questions, question assumptions, and to follow reasons and evidence courageously wherever they may lead. Critical thinking is the liberating force in a liberal education. It frees one's mind to explore, to examine, to learn, and to improve upon what has gone before, and so, therefore, critical thinking is a major threat to mindless orthodoxy and its purveyors and its minions. Which means that encouraging people to reason well, and teaching them how to do so, can be dangerous. Ask Socrates. As we once cautioned a commanding general when we were invited to do a critical thinking workshop for young officers, if you equip these officers with strong critical thinking skills

and the desire to use them, you cannot control which questions they may ask or which operational plans they may challenge. The general, to his credit and to our surprise and delight, replied that he was prepared to take that risk because what he needed most were officers who could think. Would that all powerful leaders were so welcoming toward critical thinking.

V. Summing Up

A. Questions That Matter

Our critical thinking research program has followed the path of cognitive science and relies heavily on psychometric measurement methods. Whether we are concerned with defining, teaching, measuring, or applying critical thinking, our approach is as empirical and as practical as the subject and circumstances allow. We ask ourselves: Do we really know what we think we know about training critical thinking skills or improving critical thinking disposition? Or, are we simply holding on to and voicing inherited, but unexamined, bits of professional wisdom we picked up along the way? Are our assumptions about how critical thinking is learned, taught, defined, and measured measurably accurate? For us these became research questions with empirical dimensions, and the ensuing studies provided informative results. Fortunately the research agenda was not ours alone, but that of many independent researchers because, like all good research programs, the work is only just begun.

We invite and encourage others to contribute to the investigation of questions like those listed here. While our work, and the work of others too, has advanced our understandings and aided us all moving the critical thinking research agenda forward, a great deal of scholarly work remains. Because critical thinking is so important, we believe these questions are of exceptional importance to the personal, social, professional, and civic wellbeing of people everywhere.

- How do humans, working collaboratively in groups, decide what to believe and what to do?
- How does the development of critical thinking relate to human cognitive and moral development?
- Where is critical thinking within the broader and more complex processes of human decision-making and problem solving?
- What are the risks and what are the benefits inherent in reactive versus reflective decision-making?
- How do these risks and benefits influence training (where fast, correct, and error free responses to well-defined problems is developed) as distinct from education (where more deliberative, uncertain, and time consuming responses to ill-defined problems are developed)?
- How can we best minimize the potential for errors in judgment while maximizing the potential for success in clinical settings / combat / athletics / business?
- How are fallacies and thinking heuristics alike and how are they different?
- How can individuals and groups create the time to think that is essential for reflective decision making?
- How can we override the phenomenon Henry Montgomery called "dominance structuring," the tendency to dominance structure around and bolster a given decision unreflectively?
- How can we improve our ability to be fair-minded enough to give due consideration to other options and reflective enough to reconsider decisions when necessary?
- How can groups and individuals protect themselves from wrongly framing the problem and then, as a result, solving the wrong problem? Or, from framing the problem correctly, but then using the wrong methodology in response, e.g., using ideological reasoning when the problem is empirical?
- Given the human propensity to use ideological, analogical, and empirical forms of reasoning, which are the most persuasive and which are most likely to yield the best truth in a given situation? Please forgive our use of the awkward expression "best truth." We tend to use this awkward phrase to suggest that in making a reflective judgment one will often need to consider several interpretations that lead to various truths, one of which is promises to be optimal. It's optimal because of the reasons and evidence one does supply or should be able to supply, if necessary. If we objectively and accurately map the reasoning behind a given human decision, and do this for all the humans involved in the decision, will the maps help them to resolve their differences in judgment?
- If we map an individual person's decision to engage in risky behavior, will the map help that person to identify effective ways to reduce their risky behavior?
- Can maps of risky decision-making and maps of planned problem solving be generalized to assist large numbers of people to reach better decision outcomes when faced with similar issues?

B. Two Final Suggestions

We are hesitant to offer recommendations about what other teachers and scholars should do, as they must decide based on their own individual passions. But two suggestions do come to mind:

1. Critical thinking can be a group decision making process just as it can be a process an individual uses. Let's not give up on improving our joint reasoning processes. Participate and lead others in the well-reasoned, responsible, objective, and informed decision making. Model the practice of following reasons and evidence courageously wherever they may lead, even if doing so challenges one's own cherished

beliefs or puts one's interests in jeopardy. Show how we can protect our workplaces, our communities, our schools, and our nation from the ravages of de-lusional zealots, apathetic cynics, one-rule decision makers, wedge issue polls, self-righteous extremists, moronic ignoramuses, media manipulated morons, headstrong dualists, jaded relativists, tonsorially resplendent sophists, vote-hungry podium thumpers, narrow-minded talk show hosts, and audience-chasing pseudo-journalists.

2. We believe that thinking well contributes to a happier, healthier life. So let's share the wealth whenever pos-sible. Seize opportunities to reach more students, more professionals, more friends and family. Communicate the fundamental value of reflective, fair-minded deci-sion making and show where it applies to their lives and their work, and how they can improve their skills and strengthen their positive habits of mind.

We wish again to express our sincere gratitude to the editors of *INQUIRY*, and, while we are at it, all who have taught us over the years. Thank you, colleagues, collabora-tors, students, teachers, friends, and family. We are most fortunate to have enjoyed all of the midnight conversations and day-time collaborations, and especially fortunate to be continuing our 45+ year partnership. This essay offered us the chance to pause, reflect, and refocus our current work aimed at bringing powerful measurement to users everywhere who are committed to improving our present and our future through the training and assessment of critical thinking.

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