CRITICAL THINKING AND CREATIVITY
AN OVERVIEW AND COMPARISON OF THE THEORIES

by

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Introduction

In Developing Critical Thinkers, p. 114-118, Stephen Brookfield cites a variety of researchers' main thinking on creativity, positing that creative thinking is one aspect of the development of critical thinking. (Brookfield, 1987) What are the commonalities between critical thinking and creative thinking? To me, the two appear to be in opposition to one another, since critical thinking is about evaluation of ideas and creative thinking is about expansion of ideas. I have always been known as a creative person, so this topic intrigues me. I have read several books in the popular psychology world about creativity, including works by von Oeck, deBono, Gelb, and Buzan. I have looked at materials designed to expand creativity in individuals, and was even asked to review a book on creativity for T+D magazine, ASTD's flagship journal. When these two topics were juxtaposed, it sent me on a search for additional information.

Interestingly, one of the techniques of creative thinking is to juxtapose unrelated topics to see what evolves from matching them. I am not the only one to have done this with creativity and critical thinking, and much of the literature I found matching the two is for K-12 teachers, because the teaching of these two concepts and practices is being strongly advocated in many public schools.

In this paper, I plan to review some of the scholarly literature about creativity and critical thinking, looking for commonalities between them. I also plan to compare the public trade books about creative thinking and explore how that thinking aligns with the research. Finally, I would like to explore if the relationships between them can strengthen my creative and critical thinking abilities.

Initial Research Impressions

The literature is quite comprehensive on critical thinking and creative thinking. There is very little agreement among authors on definitions of what they are, and most of the scholarly research is comprised of quoting one another. There is research in academia, psychology and business covering each topic with strong opinions and recommendations.

Research Findings

Research on Critical Thinking

In exploring the initial research on critical thinking, there are quite a variety of opinions defining it. In our text, Brookfield (1987) defines five aspects and four components of critical thinking (p. 5-9):

Aspects of critical thinking:

1. Critical thinking is a productive and positive activity.
2. Critical thinking is a process, not an outcome.
3. Manifestations of critical thinking vary according to the contexts in which it occurs.
4. Critical thinking is triggered by positive as well as negative events.
5. Critical thinking is emotive as well as rational.

Components of critical thinking:

1. Identifying and challenging assumptions is central to critical thinking.
2. Challenging the importance of context is crucial to critical thinking.
3. Critical thinkers try to imagine and explore alternatives.
4. Imagining and exploring alternatives leads to reflective skepticism.

W. Huitt, on Educational Psychology Interactive (Huitt 1994) provides a wonderful summary of the changing definitions:

> "The definition of critical thinking has changed somewhat over the past decade. Originally the dominion of cognitive psychologists and philosophers, behaviorally-oriented psychologists and content specialists have recently joined the discussion. The following are some examples of attempts to define critical thinking:
>
> - ...the ability to analyze facts, generate and organize ideas, defend opinions, make comparisons, draw inferences, evaluate arguments and solve problems (Chance,1986, p. 6);
> - ...a way of reasoning that demands adequate support for one's beliefs and an unwillingness to be persuaded unless support is forthcoming (Tama, 1989, p. 64);
> - ...involving analytical thinking for the purpose of evaluating what is read (Hickey, 1990, p. 175);
> - ...a conscious and deliberate process which is used to interpret or evaluate information and experiences with a set of reflective attitudes and abilities that guide thoughtful beliefs and actions (Mertes,1991, p.24);
> - ...active, systematic process of understanding and evaluating arguments. An argument provides an assertion about the properties of some object or the relationship between two or more objects and evidence to support or refute the assertion. Critical thinkers acknowledge that there is no single correct way to understand and evaluate arguments and that all attempts are not necessarily successful (Mayer & Goodchild, 1990, p. 4);
> - ...the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Scriven & Paul, 1992);
> - reasonable reflective thinking focused on deciding what to believe or do (Ennis, 1992)."

Huitt also explores the perceptions of the various disciplines' impact on critical thinking by looking at the influences of cognitive and behavioral psychologists, philosophers, and content specialists. Each processes the concept through a very specific lens.

Peter Faccione (1998) introduces a five-step process of critical thinking: interpretation, analysis, evaluation, inference skills, presenting arguments, and reflection that may be used in the critical analysis process. His paper also quotes an "expert consensus statement regarding

critical thinking and the ideal critical thinker" (Fig. 1) created by a two year long research

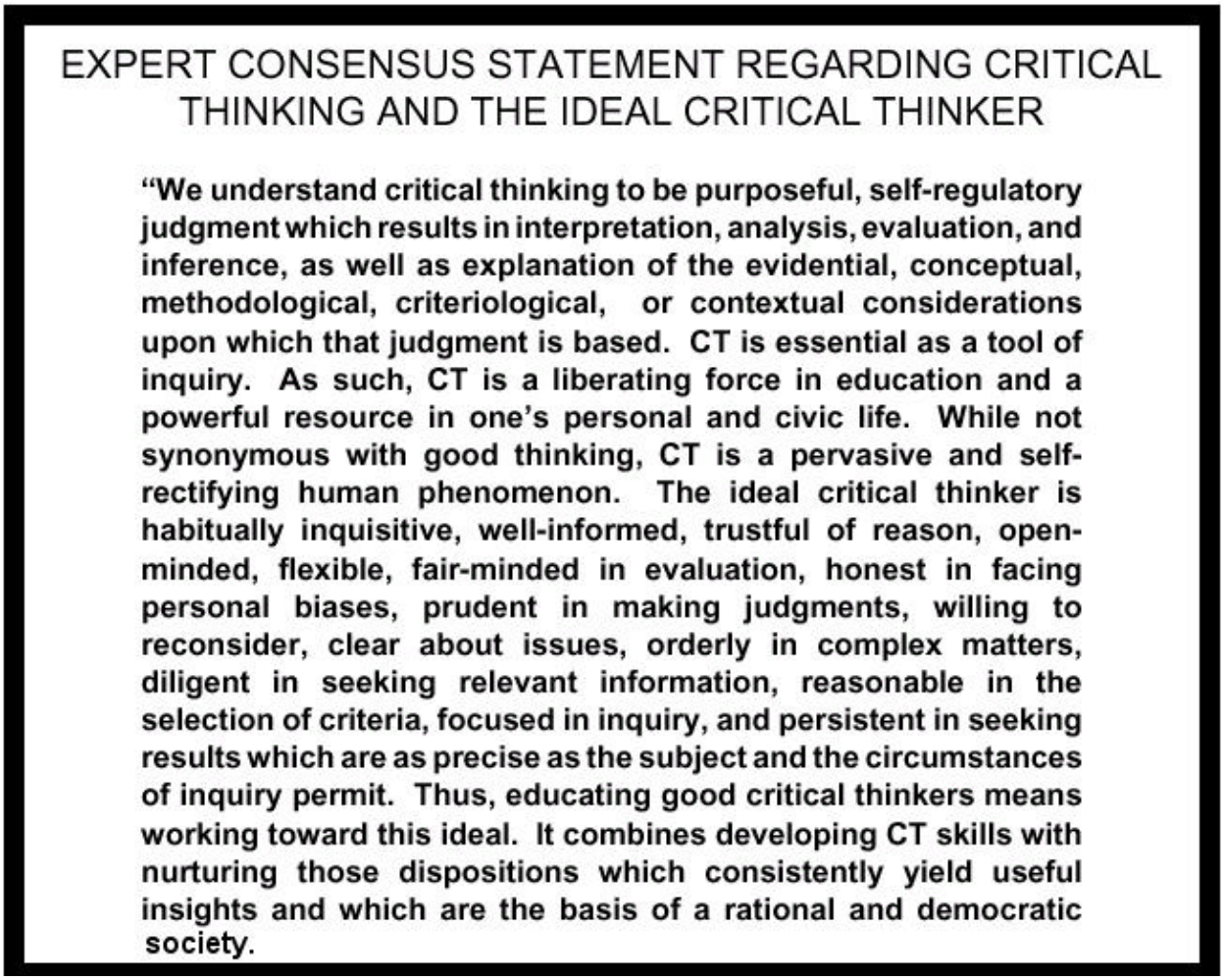

Figure 1

panel's work sponsored the American Philosophical Association in 1990. The following table summarizes what these concepts mean to this group.

Expert Consensus Panel Definitions

Interpretation	"to comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures or criteria."
Analysis	"to identify the intended and actual inferential relationships among statements, questions, concepts, descriptions or other forms of representation intended to express belief, judgment, experiences, reasons, information or opinions"
Evaluation	"to assess the credibility of statements or other representations which are accounts or descriptions of a person's perception, experience, situation, judgment, belief, or opinion; and to assess the logical strength of the actual or intended inferential relationships among statements, descriptions, questions or other forms of representation."
Inference	"to identify and secure elements needed to draw reasonable conclusions; to form conjectures and hypotheses; to consider relevant information and to educe the consequences flowing from data, statements, principles, evidence, judgments, beliefs, opinions, concepts, descriptions, questions, or other forms of representation."
Explanation	"to state the results of one's reasoning; to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological, and contextual considerations upon which one's results were based; and to present one's reasoning in the form of cogent arguments."

Critical thinking therefore requires the understanding of a broad knowledge base, the ability to identify inferential relationships, examining the credibility of the statements, the search for elements to draw conclusions, and the ability to explain the reasoning to get to this point. This analysis process is quite different from the other literature that had more parallels to creative thinking processes.

Brookfield advocates a process of a critical thinker's examination of information looking at the epistemological, experiential, communicative and political perspectives of the source information. This is somewhat similar to deBono's Six Hat process mentioned later, but with a different end product. It appears that the process literature and the definition literature about critical thinking focus on different angles. While the defining literature has numerous similarities, the processes are quite different.

Research on Creative Thinking

The research on creative thinking largely deals with the individual and how the creative process works. There are some articles about corporate creativity in particular, a fascinating one by Keith Sawyer (Sawyer 1999) that explores group creativity involved in improvisational theater. Many of the articles deal with application of creativity in the workplace, and the removal of the barriers that constrain individuals from being creativity. There are many models presented, involving convergent/divergent thinking, the four P's: a process, a product, a person and a press (Rhodes and Brown, quoted by Feldhusen and Goh, 1995), deBono's Lateral thinking, etc. One of the common themes is letting go of the restrictions that define what is "right" and postulating numerous hypotheses. "Everyone knows that instant judgment is the enemy of creativity," (de Bono, 1995) It isn't necessarily that all judgment is wrong; it's allowing the ideas to emerge without screening them out. It is repeatedly mentioned that there is a need for a quantity of ideas for a good one to emerge.

Like critical thinking, creativity is viewed as a process rather than a product, and within the variety of theories, one defined creativity as needing to have an expert determine if something is creative, and another just holding the process as the creative portion. It is generally measured by creative output, relying on the assumption that "those with higher creative potential have higher creative output…[or] mastery of the discipline…[relying] on the observation that creativity tends to be domain-specific—that is, most highly creative people are creative only within a single discipline." (Smith, Paradice et al., 2000)

Creativity is defined as something different from intelligence, (Michalko, 1998). "Creativity is often defined as a parallel construct to intelligence, but it differs from intelligence in that it is not restricted to cognitive or intellectual functioning or behavior. Instead, it is

concerned with a complex mix of motivational conditions, personality factors, environmental conditions, chance factors, and even products." (Feldhusen and Goh, 1995) It is different from innovation, since

> "innovation is 'ideas to action'—taking something that seems to be a good or even exceptional idea and transforming it into something that it tangible for others to use. Innovation is an active process that has a clearly defined end or goal and that produces something that others can use and indeed want! …The goal, if not drive, of creativity is to explore beyond current reality, to realize something new. On the other hand, the goal of innovation is to bring those novel ideas into a tangible form that in some way conforms to what others need in the here and now. Creativity is essentially a divergent activity, expanding beyond current experience, while innovation is essentially a convergent activity, bringing those same ideas back into people's experience…creativity is an aspect of innovation;…the goal of creativity is exploration and invention. The goal of innovation is transformation and implementation."
>
> (Richards, 2003)

Interestingly, innovation is called a convergent activity here. That concept is usually associated with critical thinking. Perhaps innovation is the connecting piece between the two.

Innovators like Joyce Wyckoff of thinksmart.com consider creativity to be a component of innovation. Many of the concepts found in creative thinking literature are included in her model of Innovation DNA (Wycoff 2002). (Figure 2) She considers creativity to be "a natural ability of every person, [and] the skill of developing a lot of ideas and connecting diverse concepts can be enhanced through training and exercise. It is up to the leadership to provide the direction and stimuli to spur creativity." She names nine components of personal innovation. Several of these overlap with steps involved in the critical thinking process, indicated with an asterisk (*):

A. Commit to the exploration and development of new possibilities

- Look for "a better way" and challenge the conventional approaches and answers. *
- Embrace change and actively explore uncharted territory.
- Facilitate development of stimulating challenges that energize and engage.
- Embrace diversity as a vital source of new perspectives & possibilities.

B. Seek out new connections between unrelated concepts *

- Regularly read the world for new trends, technologies, ideas and information.

- Understand thinking styles and think with whole brain and all senses. *
- Remain open minded and search for opposites, anomalies and outliers. *
- Find or create new combinations and synergies.

C. Commit to the creation of customer value

- Understand customer needs, goals and paradigms.
- Understand the strategic context and aim for win-win.
- Strive to elegantly deliver more with less.

D. Integrate the specific business strategy with the process of innovation

- Understand the current art, science and language of the business area.
- Know the background and context well enough to recognize ideas that are innovations.
- Master the basic tools and methods in the area of exploration and idea generation.
- Understand the system of innovation and allows time for each step of the process.

E. Build alignment around new possibilities

- Paint the WOW! picture of the future.
- Relate new ideas to existing business strategies and objectives.
- Speak to the styles and concerns of each stakeholder.
- Honor ideas regardless of origin.

F. Cultivate collaborative relationships intentionally

- Build trust implicitly and explicitly, removing fear wherever possible.
- Respect rights and opinions of others.
- Express appreciation and honest concerns.
- Value the intent and context of collaborative relationships, inside and outside the organization

G. Embrace and manage appropriate risk taking

- Take calculated and appropriate risks to advance ideas.
- Able to predict and track existing and emerging risks. *
- Communicate risks appropriately. *

H. Effectively manage *innovation* projects

- Employ tools, processes and techniques flexibly and effectively.
- Honor and manage requests, offers and promises.
- Focus on the germane issues and juggles priorities.
- Scan the business climate to optimize timing for actions.
- Establish sound evaluation criteria to guide effective decision-making. *
- Elicit the agreement of “done.”

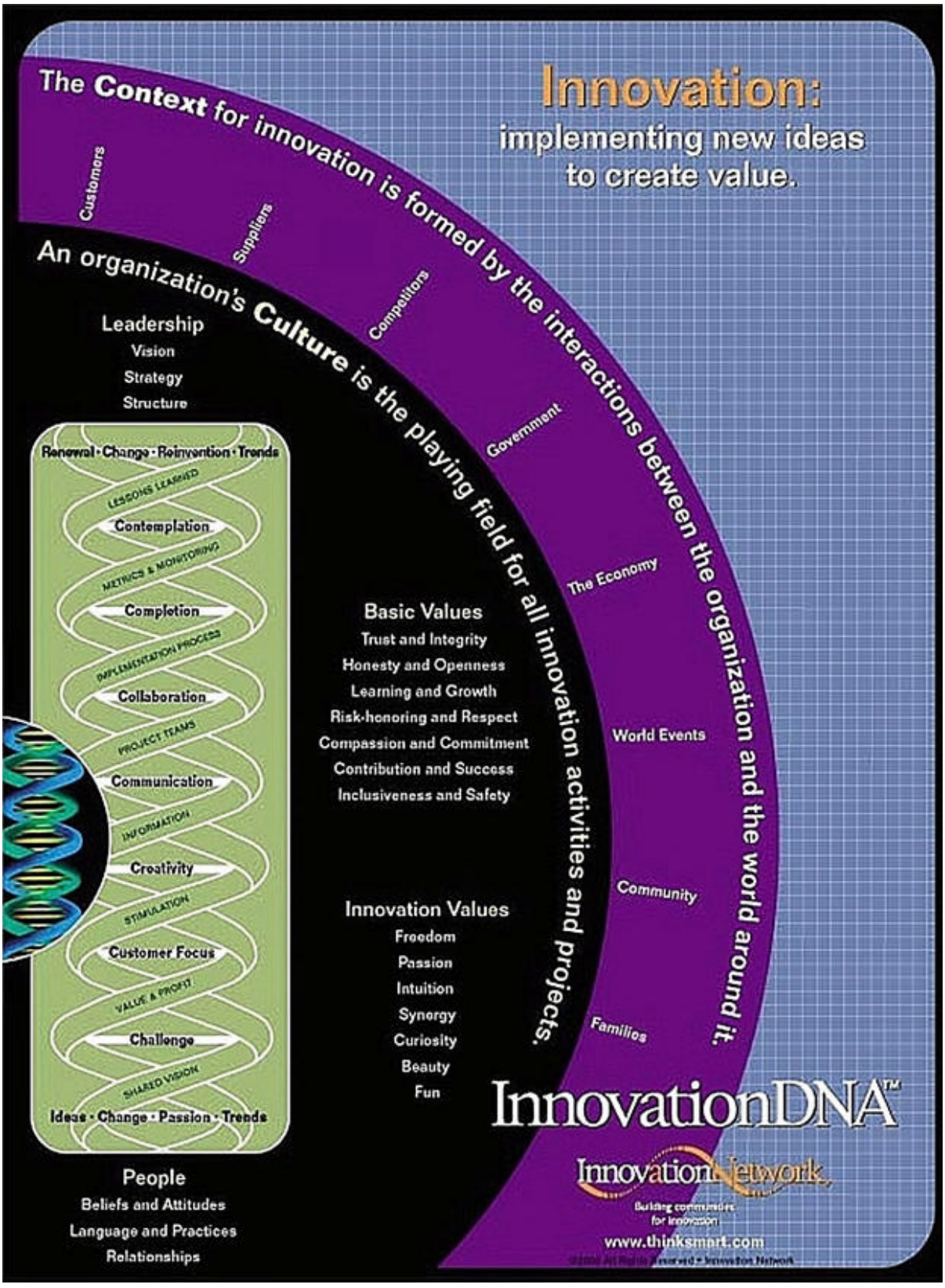
Innovation:
implementing new ideas
to create value.
The Context for innovation is formed by the interactions between the organization and the world around it.
Customers
Suppliers
Competitors
Government
The Economy
World Events
Community
Families
An organization's Culture is the playing field for all innovation activities and projects.
Leadership
Vision
Strategy
Structure
Basic Values
Trust and Integrity
Honesty and Openness
Learning and Growth
Risk-honoring and Respect
Compassion and Commitment
Contribution and Success
Inclusiveness and Safety
Innovation Values
Freedom
Passion
Intuition
Synergy
Curiosity
Beauty
Fun
Renewal · Change · Reinvention · Trends
LESSONS LEARNED
Contemplation
METRICS & MONITORING
Completion
IMPLEMENTATION PROCESS
Collaboration
PROJECT TEAMS
Communication
INFORMATION
Creativity
STIMULATION
Customer Focus
VALUE & PROFIT
Challenge
SHARED VISION
Ideas · Change · Passion · Trends
People
Beliefs and Attitudes
Language and Practices
Relationships
InnovationDNA™
Innovation Network
Building communities for innovation
www.thinksmart.com

Figure 2

Creativity is something that "deviates from past experiences and procedures," (Michalko 2000). "Creativity usually has been defined as the production of novel ideas that are useful and appropriate to the situation (Amabile, 1983; Mumford & Gustafson, 1988, as quoted in Unsworth, 2001). Leonard and Swap believe "the creative process…consists of 1) preparation, 2) innovation opportunity, 3) divergence or the generation of options, 4) incubation, and 5) convergence or the selection of options." (Kelly 2000) Here we combine divergence, convergence and innovation all under the creative umbrella.

Some speak of creativity as the process of discovery. It is more than cognitive functioning. Albert (1990, as quoted in Feldhusen and Goh, 1995) proposes six guiding ideas to "grasp the essence of creativity."

1. Creativity is expressed through decisions, not products.
2. Knowledge of self and of one's world is the medium of creative behavior.
3. Creative behavior is highly intentional.
4. Creativeness and personal identity are emergent.
5. #3 and #4 are mutually dependent.
6. Creative behavior engages individuals at the personal level of their identities and abilities.

Feldhusen and Goh quote several other popular definitions:

> "MacKinnon (1962): [Creativity] involves a response of an idea that is novel or at the very least statistically infrequent. But novelty or originality of thought or action, while a necessary aspect of creativity, is not sufficient. If a response is to lay claim to being part of the creative process, it must to some extent be adaptive to, or of, reality. It must serve to solve a problem, fit a situation, or accomplish some recognizable goal. And thirdly, true creativeness involves sustaining of the original insight, an evaluation and elaboration of it, a developing of it to the full. Creativity, from this point of view, is a process extended in time and characterized by originality, adaptiveness, and realization."

> "Czikszentimihaly (1990) theorized that the focus of creativity is in social systems and in making judgments about individuals….Creativity is an interaction among a domain, a person, and a field….it is a process that occurs outside the person who is creative."
>
> "Amabile (1990) [sees creativity as a five stage process. Stage One] conceptualizes the external input as an incoming stimulus but also sees the initial impetus as coming from within the individual. Stage 2…acknowledges the role of information or knowledge input. Creative processing then involves memory and environment search, response generation (Stage 3), and response evaluation (Stage 4). The culmination in Stage 5 is success, failure, or partial success. Influencing the whole creative process are task motivation, domain-relevant skills, and creativity-relevant or processing skills."
>
> "Brown (1989) sees creativity as an unconscious process, but as an aspect or component of more complex behavior such as problem solving…emphasizing the role of problem finding as an element of creative behavior, as well as the possible fole of change factors in creativity….Chance may favor the well prepared and the very active mind."

Feldhusen (2002) himself makes a very interesting observation that creativity has much to do with the person's existing knowledge base, especially within children. Torrence's model of fluency, flexibility, originality and elaboration requires a significant knowledge store in order to retrieve and elaborate on new ideas. In this early work (1947) creative people were accelerated in school, had a large knowledge base, and were "characterized by ability to stick with a task for a long time." Feldhusen speaks of the large knowledge base assisting in the divergent thinking processes of idea generation. According to Smith, et al (2000) there are three categories of knowledge essential to "prepare the mind for creative endeavors: 1) Knowledge of the domain in which one intends to create, 2) knowledge of techniques that enhance creativity and factors that inhibit creative efforts, and 3) knowledge of other domains…[K]nowledge of other domains provides the material needed for construction useful analogies and.. one domain may have a solution that can be adapted and reused in another."

Mnemonics like Alex Osborne's SCAMPER (Michalko 2000) representing

- Substitute?

- Combine?
- Adapt?
- Modify, magnify or add?
- Put to other uses?
- Eliminate?
- Rearrange or reverse?

are common in the literature, providing a process for the individual to utilize to become creative. Tactics like reversals break existing patterns, "destabilize conventional thinking patterns and free new ideas." There are suggestions to not think about something and let the subconscious process the information, and to use the ridiculous to spur on new ideas. (Michalko 2000) Writers explore the thinking of geniuses, in hopes that the reader might emulate some of their patterns. Howard Gardner began his explorations in to multiple intelligences by examining the thinking of geniuses. Michalko (1998) lists the thinking patterns of geniuses as follows:

1. Geniuses look at problems in many different ways
2. Geniuses make their thought visible
3. Geniuses produce many ideas
4. Geniuses make novel combinations
5. Geniuses force relationships
6. Geniuses think in opposites
7. Geniuses think metaphorically
8. Geniuses prepare themselves for chance

Not surprisingly, these patterns parallel many of the creative ideas and methods in the literature.

There are numerous books in the business and self help sections in bookstores and libraries on increasing creativity. Books like Chic Thompson's *What a Great Idea!* (Thompson 1992) include formulas and exercises to encourage freedom from old ideas, expression of new ideas, learning to create by changing perspectives, thinking in opposites, metaphors, future tense, then taking action to use the ideas. According to Smith, Paradice et al. (2000) there are four behaviors that prepare the mind for creativity: 1) learn something new every day, 2) seek out

constructive criticism, 3) incubate, or leave a problem alone for a while to allow the brain to work on it, and 4) put knowledge to work.

Sometimes creativity is about letting go of existing ideas to come up with something new. According to Dee Hock, founder of Visa "The problem is never how to get new, innovative thoughts into your mind, but how to get old ones out." Roger von Oech, in *A Whack on the Side of the Head*, lists mental blocks that stifle creativity: Finding *the* right answer, requiring something to be logical, following the rules, always being practical, and assuming play is frivolous. These are all about letting go of pre-existing ideas to allow for the creative ones.

Thomas (1999) is one of the many who lists barriers to creativity. His list is based on the work of Alexander Hiam, and lists nine:

1. Failure to ask questions
2. Failure to record ideas
3. Failure to revisit ideas
4. Failure to express ideas
5. Failure to think in new ways
6. Failure to wish for more
7. Failure to try being creative
8. Failure to keep trying
9. Failure to tolerate creative behavior

Most authors in this vein believe removing the obstacles to creativity fosters it.

Sometimes creativity is about exploring things from new perspectives. Edward deBono teaches what he calls Lateral Thinking Skills (de Bono 1995). One of his methods, the Six Thinking Hats, involves putting on a different “hat” to look at ideas. He color codes his hats:

- White—facts figures, information, asking questions, defining information needs and gaps
- Red—intuition, feeling and emotions
- Yellow—logical positive, why it will work and offer benefits
- Black—logical negative, includes judgment and caution

- Green—creativity, alternatives, proposals, what is interesting, provocations, and changes
- Blue—overview or process control

Using deBono's system, ideas are explored from a variety of angles. DeBono's other concepts of lateral thinking are designed to circumvent the brain's natural patterns and tendencies. He also created the concept of PO, or provocation operation, which is designed to break out of existing patterns. There is a deliberate sense of looking at opposites, or reversals, or exaggerations to explore concepts from a different angle. One other method deBono uses is to introduce a random word into the discussion. Mixing in an unrelated concept causes the brain to think in a different direction and come up with new links, combining previously unrelated ideas to form new ones.

While creativity is largely viewed as an individual process, there is also literature on organizational creativity, and what it takes to promote creativity within organizations. Constantine Andriopoulos (2001) of the Hunter Centre for Entrepreneurship hosted in the University of Strathclyde in the United Kingdom looks at creativity from an organizational viewpoint. Similar to some of the writings on learning organizations in the United States, he posits that there are five organizational factors that enhance creativity in a work environment. First, the organizational climate requires "participation and freedom of expression, but demands performance standards" and must be "open climates" where there is interaction with small barriers, a large number of stimuli, freedom to experiment, and the possibility of building on earlier ideals." Secondly, the leadership style must be democratic and participative. Thirdly, the organizational culture must be "innovative (divergent and learning) and supportive (empowering and caring" as opposed to controlling and directive. There must be an open flow of communication, and the culture must encourage and support risk-taking, as well as self-initiated

activity. The culture must be "stimulating and ensuring participative safety…employees can only be encouraged to think creatively if they are not afraid of criticism and punishment." The organization must work to attract creative talent with the resources and skills in place, them work to develop those talents. Finally, the structure and systems of the entire organization must support creativity. These factors are in alignment with the types of activities that creative people take, and putting them in place in an organization would encourage creativity by its employees. Gareth Lewis, as quoted in Human Resource Management International Digest (2002) states, "Although people are clearly naturally creative in the ways they approach the world around them, this aspect of human behavior has not always been encouraged or acknowledged by organizations in which people work." Like critical thinking, creative thinking must be fostered to develop. "Creativity and innovation are the life's blood or organizations in the information age. [It is a myth] that creative output depend[s] on the inspirations of a few, often flamboyantly different individuals….it is a process in which both groups and individuals play important roles. Regardless of the size of the organization, the creative process is essentially the same. It consists of 1) preparation, 2) innovation opportunity, 3) divergence or the generation of options, 4) incubation, and 5) convergence or the selection of options…Managers can shape the creative process, design the group composition, enhance the physical environment, provide the tools and techniques to move things along, and lead the creative change…" (Kelly 2000)

Mauzy and Harriman (2003) review three climates for creativity. "Groups, like individuals, perform more creatively when intrinsically motivated. Climates conducive to creativity nurture the individuality at the heart of intrinsic motivation. They provide the safety necessary for curiosity to flourish. They provide support and patience for successful evaluation. They expect newness." Looking at Hallmark, Hewlett-Packard and NetGenesis, they found

significant differences in the way these were individually established, but similarities in the creation of a specific climate to foster and hire creativity, collaboration, open feedback, and the acknowledgement and rewarding of creative moments.

Research Mentioning Both Critical and Creative Thinking

In most of the education-oriented material, the definitions are highly watered down. Bloom's Taxonomy is often referenced, using the higher level thinking skills to connect to critical and creative thinking. "Critical thinking involves logical thinking and reasoning…creative thinking involves creating something new or original…While critical thinking can be thought of as more left-brain and creative thinking more right brain, they both involve "thinking." When we talk about HOTS "higher-order thinking skills" were concentrating on the top three levels of Bloom's Taxonomy: analysis, synthesis and evaluation." (Lamb 2003) Huitt equates evaluation with critical thinking and synthesis with creative thinking:

> "Synthesis and evaluation are two types of thinking that have much in common (the first four levels of Bloom's taxonomy), but are quite different in purpose. Evaluation (which might be considered equivalent to critical thinking as used in this document) focuses on making an assessment or judgment based on an analysis of a statement or proposition. Synthesis (which might be considered more equivalent to creative thinking) requires an individual to look at parts and relationships (analysis) and then to put these together in a new and original way.
>
> There is some evidence to suggest that this equivalent-but-different relationship between critical/evaluative and creative/synthesis thinking is appropriate. Huitt (1992) classified techniques used in problem-solving and decision-making into two groups roughly corresponding to the critical/creative dichotomy. One set of techniques tended to be more linear and serial, more structured, more rational and analytical, and more goal-oriented; these techniques are often taught as part of critical thinking exercises. The second set of techniques tended to be more holistic and parallel, more emotional and intuitive, more creative, more visual, and more tactual/kinesthetic; these techniques are more often taught as part of creative thinking exercises. This distinction also corresponds to what is sometimes referred to as left brain thinking (analytic, serial, logical, objective) as

> compared to right brain thinking (global, parallel, emotional, subjective) (Springer & Deutsch, 1993)." (Huitt 1994)

The Saskatchewan School board defines both creative and critical thinking as "qualities of good thinking processes and as types of thinking. Creative thinking is generally considered to be involved with the creation or generation of ideas, processes, experiences or objects; critical thinking is concerned with their evaluation." They are "interrelated and complementary aspects of thinking." (Saskatchawan Education 2003)

There are several models that exist that work to develop critical and creative thinking in schools. Calvin Taylor, in the Talents Unlimited program (Bellis) describes the talent areas as productive thinking, communication, planning, decision making and forecasting. Productive Thinking is the process of thinking of many, varied, unusual ideas, then adding to them. Communication works with "many varied single words" describing things and feelings, then making a network of ideas and thoughts, and sharing these with others. Planning has the students think through the materials they would need, the steps to take, and the anticipation of problems. The next phase, Decision Making teaches the student to think about a variety of things that could be done (the creative aspect of generating many solutions), then thinking carefully about alternatives and choosing one, then defending the choice. Forecasting has the students making varied predictions about situations and exploring the cause and effect relationships. These steps are used when a child invents something.

Bellis also writes about Scott Isaksen and Donald Treffinger's creative problem solving model. Their basic course has six stages: mess finding, data finding, problem finding, idea finding, solution finding and acceptance finding. According to them,

"Creative thinking is described as:
- making and communicating connections to think of many possibilities;
- think and experience in various ways and use different points of view;
- think of new and unusual possibilities; and
- guide in generating and selecting alternatives.

Critical thinking is described as:
- analyzing and developing possibilities to compare and contrast many ideas
- improve and refine ideas
- make effective decisions and judgments, and
- provide a sound foundation for effective action."

Once again, we have a model of divergent thinking to create, and convergent thinking to decide.

Helgeson (1993) suggests that there are three ingredients to teaching critical and creative thinking to children through the content areas: using relevant, real world issues; providing structure to solve problems and organize information, and a nurturing classroom environment. This thinking parallels many of the suggestions mentioned in article on fostering creativity in the workplace. The environment must be supportive of the process.

In the corporate sector, Brown and Duguid (2001) discuss the tension that must exist between creativity and structure in order for an organization to survive. "Process emphasizes the hierarchical, explicit command-and-control side of organization—the structure that gets things done. By contrast, practice emphasizes the implicit coordination and exploration that produces thing to do. Practice without process tends to become unmanageable; process without practice results in the loss of creativity needed for sustained innovation…Companies that fail to control the conflicting forces of practice and process at best alternate between attempts to foster creativity and attempts to exert control." As mentioned earlier, the organization must foster creativity, but this aspect of balance is important, and involves the critical thinking, logistical elements and the realism necessary to implement the ideas, but also provide a check and balance arrangement between practice and process.

Provost and Sproul (1996) incorporate the classic work of W. Edwards Deming in looking at creativity and critical thinking in using them to create improvement in an organization.

> "Improvement comes from the application of knowledge…profound knowledge [is] the interaction of systems knowledge, knowledge of variation, knowledge of psychology, and knowledge of learning…combine with subject matter knowledge to accelerate the rate of improvement….Improvement is desirable and necessary. For such organizations, creative thinking should be viewed as an essential supplement to, though not a replacement for, critical thinking." Improvement methods may be based on either creative or critical thinking. "Creativity is the serious, deliberate, and systematic generation of new ideas, new concepts, and new perceptions of value. Creativity means escaping from existing perceptions and concepts to open up new ways of looking at and going things. It has to do with reconceptualizing systems and ideas as well as creating new ones from scratch.
>
> Tools based on critical thinking…depend on careful analysis, evaluation, and reasoning including both deductive and inductive reasoning and both analytical and systems thinking. Some of the tools provide ways to summarize and communicate existing knowledge; others focus on the collection, analysis and display of new data. They are useful in understanding existing knowledge, gaining additional knowledge and developing and testing changes."

Part of the process is designed to break away from assumptions by identifying them and challenging them. These are two common themes in critical and creative thinking.

Gillian Ragsdell (2001) writes about "critical creativity" using a process of critical systems thinking. "Being critical involves encouraging complemetarism, sociological awareness, human well-being and emancipation….complementarism could be seen in an appreciation that creativity can arise from a number of different origins—from conflict or from natural personal qualities." There are a few key principles in critical creativity. First, the systemic principle, looking at the coherent whole, then the principle of participation, where multiple views are taken into account. Finally, there is the principle of reflection, where information is pondered. "Critical creativity attempts to further the emancipation of individuals through design, debate and disemprisionment. [It] encourages participants to design freedom into their approach, to

participate meaningfully in a process of open debate and to address coercive forces that hinder attempts to free themselves of their restrictive relationships…" Some of her concepts parallel Senge's disciplines from The Fifth Discipline.

The University of Massachusetts has a graduate program that specializes in creative and critical thinking. They explain their rationale and define the two as:

> Critical thinking, creative thinking, and reflective practice are valued, of course, in all fields. In critical thinking we seek to scrutinize the assumptions, reasoning, and evidence brought to bear on an issue-by others and by oneself; such scrutiny is enhanced by placing ideas and practices in tension with alternatives. Key functions of creative thinking include generating alternative ideas, practices, and solutions that are unique and effective, and exploring ways to confront complex, messy, ambiguous problems, make new connections, and see how things could be otherwise. In reflective practice we take risks and experiment in putting ideas into practice, then take stock of the outcomes and revise our approaches accordingly. Critical thinking, creative thinking, and reflective practice are valued, of course, in all fields. In critical thinking we seek to scrutinize the assumptions, reasoning, and evidence brought to bear on an issue-by others and by oneself; such scrutiny is enhanced by placing ideas and practices in tension with alternatives. Key functions of creative thinking include generating alternative ideas, practices, and solutions that are unique and effective, and exploring ways to confront complex, messy, ambiguous problems, make new connections, and see how things could be otherwise. In reflective practice we take risks and experiment in putting ideas into practice, then take stock of the outcomes and revise our approaches accordingly."
>
> (University of Massachusetts 2003)

While UMass has a graduate program in critical thinking and creativity, concerns have been raised about the thinking emerging from the universities and the expectations of corporate America. "We look to entrepreneurs to solve old problems by introducing new products, new processes, and new organizational arrangements, often with some degree of risk. However, the personality type of the entrepreneur does not sit easily within organizations. Many of their characteristic qualities—a high challenging behavior, intrinsically motivated, poor at detail, opportunistic, curious and obsessed—would not only be out of place on a standard list or organizational competencies, but would be viewed negatively." (Kandola 2002) Sometimes the

creative mindset marches to the beat of a different drummer, and is not welcomed into the environment that is not predisposed to creativity.

Observations about the Research and Conclusions

There are certainly some overlaps in the research regarding the process of creative thinking and critical thinking. In both, we must challenge assumptions and prior knowledge. In critical thinking we do this to determine accuracy and validity of the statements, and in creativity to go beyond them, as in Donoghue's concept of thinking further. (Donoghue 2003) His concepts of thinking further suggests we must take new perceptions of things, and not take them at face value. In creative thinking, the first solution is not always the best solution, though it may be right. In critical thinking, the presented solution may be accepted or rejected. Thinking further also requires us to create new frames of reference, as athletes need to do when the world record of running a mile could be broken again and again. Old thinking prohibits creativity and is accepting of what is presented without a critical examination of it.

Both consider the thinking as processes rather than products or outcomes. Both involve the re-examination of existing information. It appears that creativity takes the next step after challenging assumptions and begins creating new ideas. Critical thinking challenges, but draws conclusions, rather than taking the concepts to new dimensions. Creative thinking is designed to create, and critical thinking is designed to analyze. It seems that creative thinking has aspects of critical thinking, and critical thinking has aspects of creativity. Like deBono's thinking hats the process of looking at the alternative perspectives brings out the end result in both.

Each has value, and when used in conjunction, creates a powerful process of higher order thinking.

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