SCIENCE SET
OPEN ACCESS PUBLISHERS

Review Article

Journal of Critical Care Research and Emergency Medicine

To Be or To Do: John Boyd and Effective Action – Relevance Persists

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Submitted: 15 October 2024 **Accepted:** 22 October 2024 **Published:** 28 October 2024

Citation: *Matthew M Cooper (2024) To Be or To Do: John Boyd and Effective Action – Relevance Persists. J Cri Res & Eme Med 3(5), 01-06.*

Abstract

Situational awareness as practiced in its highest form allows prediction of potential future states. When combined with a foundation of recognition primed decision making, it results in necessary flexibility and adaptability as required for timely and effective action. Beginning with Energy and Maneuverability Theory, and its contributory role in the formation of Agile/Scrum, the teachings of Col. John Boyd (USAF ret.) put individuals in the center of a decision loop that can be extended to teams and culture. As such, his principles are invaluable for all who work under dynamic conditions to not only cope with their environment, also to succeed.

This article contains material previously presented at the International Conference of Aerospace Medicine, Paris, France, 22-24 September 2022

Keywords: Human Performance, Energy-Maneuverability Theory, Situational Awareness, John Boyd, OODA Loop

Introduction

Consideration of human performance in virtually any context must include an understanding of human strengths, limitations, and weaknesses as we perceive, process information, and interact with our relevant environment. This is the concept known as situational awareness (SA), the full and predictive awareness of what is all around (Figure 1). Situational awareness is both an individual and a shared construct and is the foundation of optimized decision making – our ability to reliably assess the present and predict the potential future state. Effective decision making is then at the heart of effective action and performance. Loss of situational awareness results in ambiguity, confusion, and decreased communication [1, 2].

We work in increasingly complex environments, particularly in health care and in abnormal regimes. There is a resultant increased cognitive load as a threat to SA. As the load increases, we must sort and process the influx of information. We know that human brains are superior at visual recognition, but inferior at processing. Think of the striking demonstrations of our inattentional blindness (Gorillas in Our Midst [3]. We are also limited as humans in our ability to incorporate new information and change the direction of our decision vectors. We typically have imperfect or incomplete information and need to perform beyond recognition primed decision making in which we apply what we have seen before that is identical or similar to the challenge at hand [4]. David Spirk, Jr., Chief Data Officer, SOCOM, highlighted the need to predict an adversary's next move. The charge is to get the "…right information to the right person at the right time and in the right format…[to] actually take some kind of action" [5]. That adversary could be the patient's manifest disease state. The commonality is that necessary flexibility and adaptability are required for timely and effective action.

Paradigms exist for culture, infrastructure, and human interaction for creation of a healthy learning ecosystem. Success in response to robust challenge mandates dependence on our ability to see, to analyze, synthesize, and understand, and to act.

Col John Boyd, USAF (Ret.)

Who was John "Forty Second" Boyd? ** Why are his teachings of importance and of continuing critical relevance? Boyd's teachings put individuals in the center of a decision loop that can be extended to teams and culture. As such, his principles are invaluable for all who work under dynamic "conditions of stress and uncertainty" to not only cope with their environment, also to succeed [6].

**Why was he known as "Forty-Second" Boyd? Legend has it that he defeated all adversaries in a 1 v. 1 aerial encounter within forty seconds.

Boyd was a student, interpreter, and expert applicant of history, strategy, and philosophy. As logician and theoretician, the following were foundational to his work and principles:

- **Second Law of Thermodynamics:** The tendency of entropy is to increase over time.
- **Heisenberg's Uncertainty Principle:** The inherent uncertainty of measuring multiple variables at the same time, classically position and momentum.
- **Gödel's Incompleteness Theorem:** Perhaps the most deeply theoretical in defining the formal predictability of systems with respect to completeness and consistency.

As a historian and strategist, his study spanned from Sun Tzu to the present (Figure 2). His career included fighter pilot during the Korea and Viet Nam periods, Instructor at USAF Weapons School, assigned Pentagon Tour, and a military strategist whose work became foundational to USMC doctrine and was embraced by US Special Operations Forces. Boyd's knowledge was imparted in a series of briefings, partially transcribed in a series of papers, and mostly shared orally. His works were not published in the standard sense (Appendix 1).

Boyd's Energy and Maneuverability (E-M) Theory is graphically summarized in Figure 3. It was integral to the provenance of the Lightweight Fighter (LWF) Program, and Boyd is considered to be in part "Father" of the F-15, F-16, and F-18. This is much more than airplanes with big engines, however. Consider change management, evolution in patient care, virtually all endeavors. They are guided by radius, rate, and tolerance (Gs in the aviation model)

Specifically, how much space do we have to operate within? This includes bandwidth in terms of required expertise contained within or accessible by the enterprise, and resource availability, including personnel and funding. The next consideration is the required rate of change or response. Speed is usually of the essence, if not merely optimal, and often the crux of any decisive advantage against an adversary, whether a fighter or an emerging pandemic pathogen. Decisive advantage may be lost if action is too slow. Human pilots and airframe structural materials and strength limit the magnitude of multiples of gravity that are tolerated (and survivable) during a maneuver. So too are organizations limited by their tolerance of duress, pressure, change calendar/number of contemporaneous initiatives etc. that is reflected as well in the magnitude of the overall change and the rate at which it is to be operationalized.

The requirement of speed and accuracy together is not new. Wyatt Earp is quoted as saying that "Fast is fine, but accuracy is final." More recently it has been stated that while precision and speed are critical, the "…luxury of waiting till perfect doesn't exist" [5]. Perhaps in our modern world it isn't so much what we know that gives us an edge, rather how fast we can figure the meaning of what is new and respond.

Advantage is gained by execution of "Fast Transients," operating within an opponent's decision cycle. Decisive edge results from altering the situation more rapidly than the opponent can comprehend [7]. For example, implementation during the initial stages of the COVID-19 pandemic was wanting. We were slow to figure out and disseminate treatment of silent or "happy" hypoxemia, pivot to prone positioning, develop effective testing, and vaccination strategies. Were we able to act optimally within time cycles of the development of herd
immunity and viral mutation?

The concept of Fast Transients remains valid and functions optimally for an enterprise when combined with utilization of Commander's Intent (initiative of subordinates harmonized with overall intent/strategy, distributed decision making, and a "multiplier" philosophy that supports the creativity and initiative of all members of the organization [7-9]. In order to prepare and develop teams to assume what is needed, you must consciously attract, nurture, value, and retain talent. This is increasingly difficult in the modern post pandemic world, thus underlining the importance of the multiplier approach.

System Attributes

Boyd's organizational climate and contained fundamental system components derive from his deep and extensive philosophical, strategic, and scientific studies as combined and modified with the real time demands of operational decisions and the need to deal with the consequences (Figure 4). He described an effective organization with the system attributes of finger-tip feeling, one-ness or unity, shared focus, a contract for intent or Commander's Intent, and agility. The finger-tip feeling is a precise appreciation of capabilities and limitations that are then wielded with nuance and dexterity. It may apply to the individual, the team, or the larger enterprise with an individual appreciation of who has and who does not possess requisite dexterity. The oneness dates back to the earliest strategic writings and characterizes the shared accurate mental model of the current dynamic state with respect to external and internal components. It has been well-described as: "Mutual understanding, anticipating others' thoughts, developed through familiarity and trust, based on shared philosophy and experience" [10]. The emphasis on shared focus is clear as it is called out as a distinct component.

Contract for Intent is the same as the previously referenced Commander's Intent. Commander's Intent fosters and encourages initiative of subordinates that is harmonized with superior intent. Such delegated freedom of action at presumed faster tempos requires distributed decision making. This latter capability is critically dependent on sharing of information across hierarchies, across silos, and across ego. Institutional knowledge grows rather than residing as the tacit possession of a few. Each team member is ideally committed to take ownership, personal responsibility, and accountability [11]. This is a critical means of enabling and empowering subordinate teams and individuals with ownership that yields several benefits. The stake (and pride) one takes in the created plan or decision, the increased rapidity of potential response that does not have to acutely travel both up and down a chain of command to be enacted, and the value in development of leadership skill in those at the front lines. This incorporates an empowered distributed decision making most useful in dealing with a dynamic opponent and an agility of response. Interestingly, "agility" carries several simultaneous meanings when discussing Boyd. As stated, an ability to rapidly discern the current state, reasonably predict the future state (i.e., SA), and act effectively is clearly part. However, Boyd goes further in an understanding and sharing of agility as an ability to break out of long-standing patterns of behavior, action, and

processes, even if they have been successful in the past. Boyd's attribute of agility includes humility and willingness to change (to assess and modify process) methods when it is foreseen that current processes soon won't work. Again, an old, preserved tenet, an ability to achieve "non-attachment" is at play; to learn from other disciplines and activities what might be applicable by venturing outside of our own historic systems and to be willing to change to insure future effectiveness. This is a foreign and very difficult concept for many organizations to both grasp and execute. However, it is a concept has been incorporated in the sinew of elite performing teams and expressed as: "There is no growth in the comfort zone" [11].

Agile/Scrum

Aspects of Boyd's concepts may be seen as contributory to Agile/Scrum and its broad applicability, not in the least in its focus on velocity and the critical nature of accuracy and speed to capture decisive advantage [12]. This is not at all surprising given that Dr. Jeff Sutherland, one of the creators, was educated at the U.S. Military Academy at West Point and trained as a fighter pilot. The importance of key aspects such as self-directed teams, velocity of work completed, definitions of "done", removal of impediments, and internal testing before quantum release find harmony with Boyd's synthesis.

The OODA Loop

The "OODA Loop" (OBSERVE, ORIENT, DECIDE, and ACT) is Boyd's culminating model of situation awareness, analysis, and response (Figure 5). The OODA Loop does not work sequentially. Orientation is the most important aspect as it also carries all of the biases and assumptions inherent in human nature. It shapes other aspects and is in turn shaped by feedback and sensed phenomena. Actions must flow smoothly and rapidly from Orientation, otherwise one hesitates and loses potential advantage. New Actions are added to the repertoire and Orientation updated. This is then repeated at accelerating rates.

Boyd taught the importance of speed in effective implementation of the OODA Loop. However, if performing the loop correctly, accuracy and speed improve together without trade-off. Orientation is both dynamic and well-matched to reality to allow actions to influence the situation and subsequent actions (Figure 6). It may be that in such a circumstance, no case exists where slower is better.

Conclusions

A review of the synthesis that informed and guided Col. Boyd has direct application to the considerations and constraints common to human endeavor, including available operating space and resources, how rapidly we may respond and pivot, and how much pressure we can tolerate to achieve change. Clearly this expose' has only superficially presented his materials. Excellent more in-depth history and content are found in Coram's treatise and Appendix 1 [13].

Among the greatest derivatives of collaboration among academia, industry, and the military is accumulating learning applied to augmenting human performance and cognition. Enhanced situational awareness optimizes decision making and fosters agile and adaptive response to the continuum of challenges in contexts from health care to corporate strategy. Boyd's models and syntheses have proven efficacy and remain of foundational value in application across all pursuits. Harnessing these will accelerate the evolution of enterprises and enable future unifying focus for necessary generational achievements.

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Appendix 1

Boyd's Body of Work (from Wetzel T – www.colonelboyd.com)

Air-to-Air Theories

- Aerial Attack Study (version dated 11 Aug 1964)
- New Conception of Air-to-Air Combat (version dated 4 Aug 1976)

General Military Theories

A Discourse on Winning and Losing

- Abstract for Discourse on Winning and Losing (undated, assessed 1987)
- **Part I:** Patterns of Conflict (version dated Dec 1986)

- **Part II:** Organic Design for Command and Control (version dated May 1987)
- **Part III:** The Strategic Game of ? and ? (version dated Jun 1987)
- **Part IV:** Destruction and Creation (version dated 3 Sep 1976)
- **Part V:** Revelation (slide dated 1987)

"'Patterns of Conflict' represents a compendium of ideas and actions for winning and losing in a highly competitive world. 'Organic Design for Command and Control' surfaces the implicit arrangements that permit cooperation in complex, competitive, fast moving situations. 'The Strategic Game of ? and ?' emphasizes the mental twists and turns we undertake to surface appropriate schemes or designs for realizing our aims or purposes. 'Destruction and Creation' lays out in abstract but graphic fashion the ways by which we evolve mental concepts to comprehend and cope with our environment. 'Revelation' makes visible the metaphorical message that flows from this 'Discourse.'"

— John R. Boyd in Abstract to "Discourse on Winning and Losing"

Conceptual Spiral (version dated Jul/Aug 1992)

Figures

Figure 1: Situational awareness is the foundation of effective decision making and action. Thanks to Michael Jorgensen, renowned fighter pilot and aviation photographer, who shared this photo.

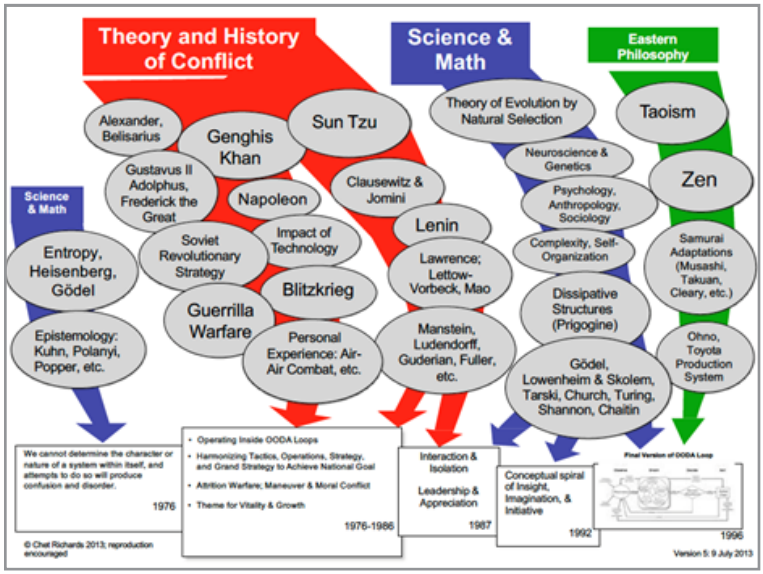

Figure 2: The theoretical and contextual foundations of Boyd's studies and ultimate syntheses. From Chet Richards 2012.

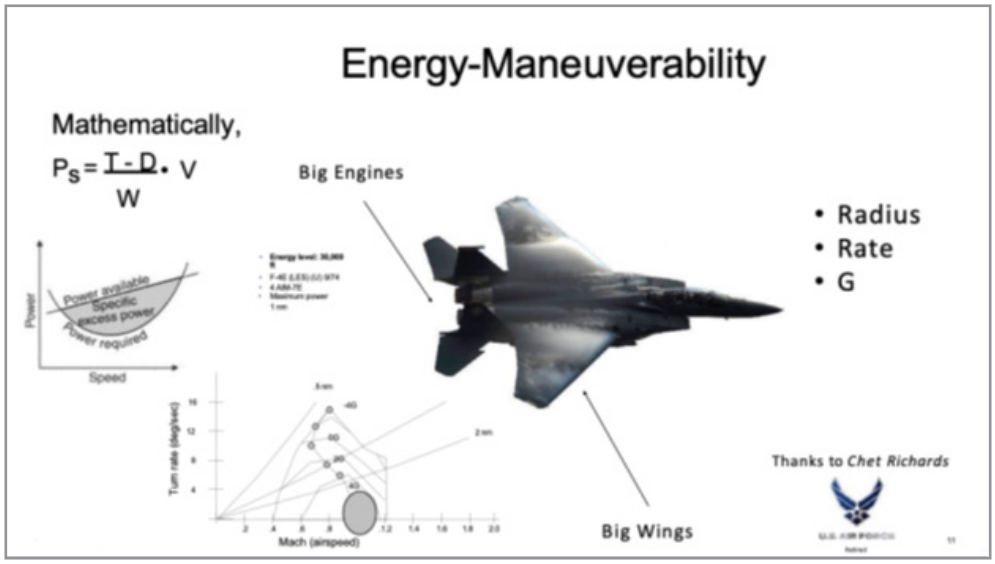

Figure 3: Graphic representation of principles and variables included in Boyd's Energy - Maneuverability Theory. Ps = Specific Excess Power, pronounced "P sub S", measures energy rate of change; T = Thrust; D = Drag; W = Weight; V = Velocity.

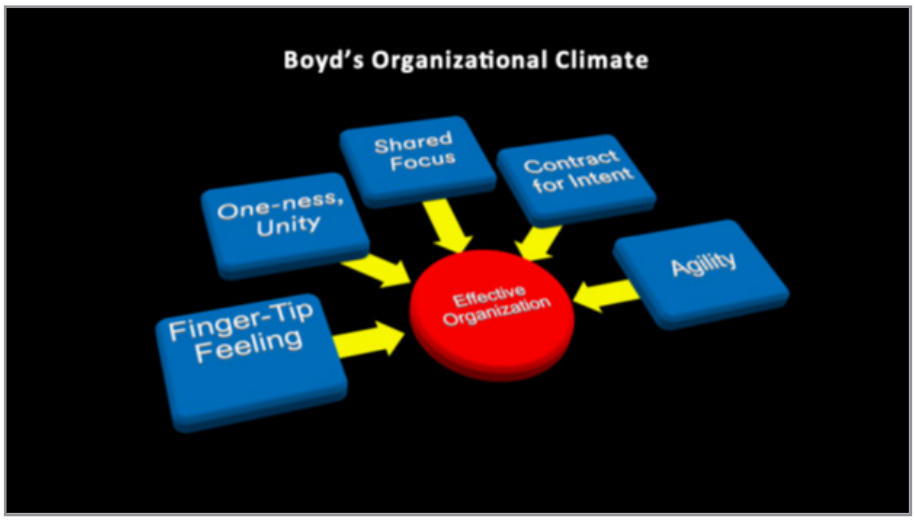

Figure 4: Boyd's idealized organizational structure to optimize perception, analysis, and effective action.

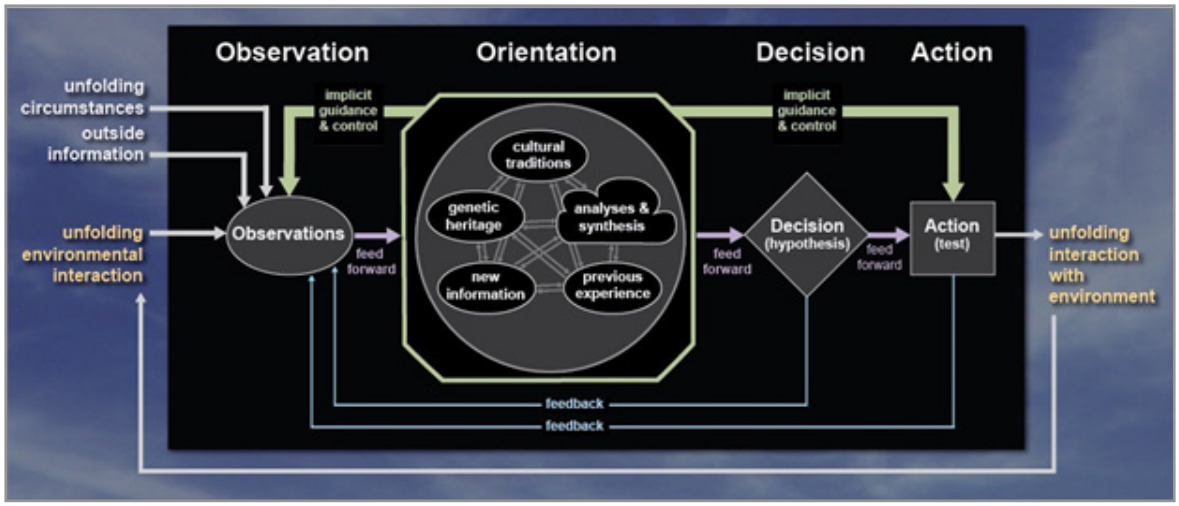

Figure 5: The OODA Loop. Note how Orientation influences Observation, Decision, and Action, and in turn is shaped by feedback and other input to our sensing and observations. Also note that the entire "loop" does not function sequentially. Modified from Boyd and Richards (6).

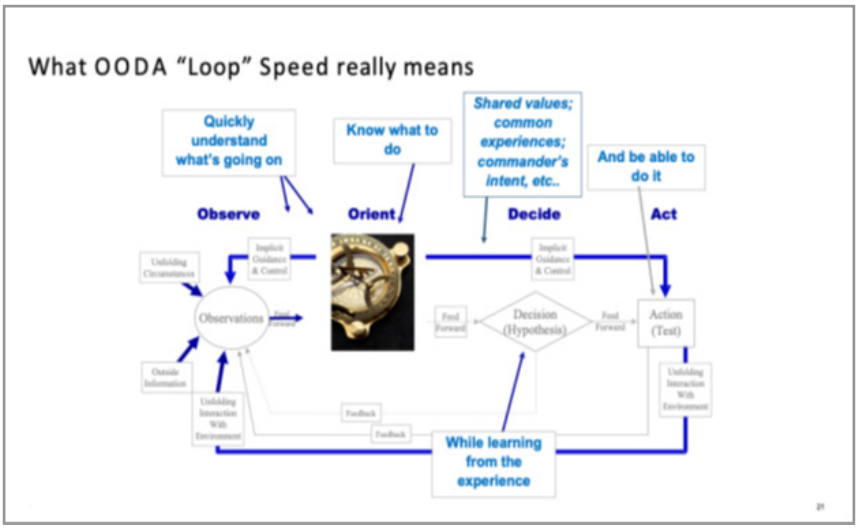

Figure 6: OODA Loop accuracy and speed ideally improve together without tradeoffs. Modified from Boyd and Richards (6).

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