

## Colonel John Boyd's Thoughts on Disruption A Useful Effects Spiral from Uncertainty to Chaos

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**Abstract:** A close examination of John R. Boyd's concept of disruption as recorded in his 1987 presentation, "An Organic Design for Command and Control." This article draws attention to a series of disruptive actions Boyd lists, including uncertainty, doubt, mistrust, confusion, disorder, fear, panic, and chaos, noting that the list begins with the mildest effect but that it progresses regularly toward collapse and chaos. The author argues that Boyd was specific in listing these effects in order and notes that this cycle could be developed into a useful effects spiral, which, once understood, can be catalyzed to enhance enemy disruption in a Joint all-domain operations (JADO) environment. In the postscript, this article argues that officers seeking to operate in a multi- or all-domain environment can benefit from a broad educational base to unlock creativity in approaching wicked problem sets. This creativity, when coupled with concepts like the effects spiral, can enhance traditional maneuver and combat, triggering an opponent's collapse without the need for annihilation.

**Keywords:** John R. Boyd, OODA, decision cycle, psychological warfare, all-domain, dislocation, strategy, JADO, JADC2, creativity, education, PME

**Y**ours Truly: Operate inside adversary's observation-orientation-decision-action loops to enmesh adversary in a world of *uncertainty, doubt, mistrust, confusion, disorder, fear, panic, chaos . . .*

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and/or fold adversary back inside himself so that he cannot cope with events/efforts as they unfold.

~ John R. Boyd<sup>1</sup>

From John Boyd we learned about competitive decision making on the battlefield—compressing time, using time as an ally.

~ General Charles C. Krulak<sup>2</sup>

## Introduction

This article considers a list of conditions or degrees of collapse noted by U.S. Air Force colonel John R. Boyd in his 1987 briefing, “Organic Design for Command and Control,” listed in the above quote. It observes that, when uncertainty and doubt are infused into a complex, adaptive system, that system can follow an entropic, cascading decline as a spiral into confusion, disorder, fear, panic, and chaos. Even if the opponent does not progress far down the spiral, uncertainty and doubt reduce the speed and quality of decision making, slowing the crucial orientation phase of the observe, orient, decide, act (OODA) loop. Further, it notes that Boyd subscribed to a systems view of opponents seen as a holistic organism, featuring multiple centers of gravity (COGs). He proposed that decisive points are often found at connections between COG as critical vulnerabilities, possibly within operational reach, as when well-defended centers of gravity prove difficult to target or as simultaneous catalyzing strikes (*nebenpunkte*). An understanding of the opponent’s many nodes and connections is fundamental. Understanding this and how conditions of the effects spiral interact enables planners and commanders to creatively mix physical and informational weapons to degrade decision-making capability or to spark a cascading collapse of the enemy within the human domain.

## John Boyd and the OODA Loop

U.S. Air Force colonel John Boyd left a rich legacy of ideas relating to war and competition. Much of it applies to the Department of Defense’s quest to operationalize Joint all-domain operations (JADO). Of course, Boyd is most famous for the OODA loop—observe, orient, decide, act—the conflict decision-making heuristic that underpins the Joint all-domain command and control (JADC2) architecture and conceptions of JADO operations.<sup>3</sup> If one is able to “turn inside” the opponent’s decision cycle, especially through superior situational awareness, the thinking goes, one can force the opponent to *re*-observe, *re*-orient, *re*-decide, and *re*-act, capturing the initiative and driving the action. This tempo and initiative-based approach has dominated American and Western thinking about war and competition since at least the post-Vietnam era, displacing conceptions focused more on mass and attrition.<sup>4</sup> Boyd’s ideas loom large in this shift, and while he was not the only one advocating this kind of approach, his perceptive synthesis and passionate crusade led the defense estab-

ishment to a new conception of war and conflict. Within the U.S. Marines, his ideas underpin the concept of maneuver warfare.<sup>5</sup>

### **Boyd's "Organic Design for Command & Control"**

Boyd was convinced that survival equated with adaptation, with openness, and that to become isolated or closed off signified defeat, dissolution, and death. In his presentations, he viewed organizations and even nations as collections of organisms forming complex adaptive systems, resilient until they were isolated.<sup>6</sup> The systems view of the environment and the opponent is as old as Carl von Clausewitz, but it was embraced as an outgrowth of the Army Air Corps and Air Force thinking with respect to bombing campaigns, expressed as industrial web theory.<sup>7</sup> Boyd took it much further, synthesizing then-current literature and seeing the enemy system as a collection of entities (what we might today call *nodes*), with crucial connections between.<sup>8</sup>

While another Air Force colonel—John A. Warden III—advocated the targeting of multiple nodes simultaneously, Boyd advocated striking connections between nodes to isolate and disrupt.<sup>9</sup> As he stated directly in his “Patterns of Conflict” briefing at Quantico, on 25 April and 2–3 May 1989, “If you want to subvert or pull apart a guy’s center of gravity . . . you want to find out what are those bonds, those connections that permit that organic whole to exist.”<sup>10</sup> Though he did not say it, such connections would be more difficult to defend, and thus softer targets than would be the key nodes themselves, often defended as known critical vulnerabilities.<sup>11</sup> In fact, he emphasized that these connections were not necessary physical when he noted, “by striking at those tendons, connections. . . . In other words, you want to generate many non-cooperative centers of gravity.”<sup>12</sup> It is a useful principle that targeters, planners, and commanders can profitably use in single-, cross-, multi-, or all-domain operations.

Boyd is also well-known for communicating through marathon briefings, conducted throughout the late 1970s, through the 1980s, and into the 1990s, most famously his monumental “Patterns of Conflict” noted above. In “Patterns,” Boyd synthesized his study of conflict, history, and strategy.<sup>13</sup> He concluded that disaggregating the opponent was ultimately the goal in any conflict.<sup>14</sup> His 1987 “Organic Design for Command and Control” applied these ideas directly to command and control (C2).<sup>15</sup> Through 37 slides, he discussed—conceptually—how to create a C2 system that maximizes adaptability, resiliency, and harmony while challenging that of the opponent. In discussing multiple, simultaneous attacks—*nebenpunkte*—he could have been discussing the foundations and aspirations for the Army’s multidomain operations or the Department of Defense’s Joint all-domain operations (MDO or JADO).<sup>16</sup>

### **An Effects Spiral**

On slide number seven of “Organic Design for Command and Control,” Boyd articulated his conditions in what appear to be just a list, but a closer look reveals a subtle but very useful scale of effects:

Operate inside adversary's observation-orientation-decision-action loops to enmesh adversary in a world of **uncertainty, doubt, mistrust, confusion, disorder, fear, panic, chaos, . . .** and/or fold adversary back inside himself so that he cannot cope with events/efforts as they unfold [emphasis added].

Boyd's slides do not characterize the disruptive effects he sought as a spiral, but nonetheless they do have a relationship to one another and were presented by Boyd in what was doubtlessly a carefully crafted order, designed such that "weaknesses thereby generate doubt and uncertainty which magnify into panic and chaos."<sup>17</sup> As effects, they are particularly useful to commanders and planners, because while one might like to immediately cause collapse through shock and awe, it may be much more realistic to seek results that multiply and magnify lesser effects such as uncertainty and doubt. This works in what we might call the human domain, the macrosphere that encompasses belief and calculation of each human in the system, characterized by unique and overlaying segments that clash in any given conflict to create a complex, adaptive system within human society, or soon, human-machine society.

The effects spiral multiplies and compounds small actions that act together to erode trust and move an individual, an organization, or a system further down the spiral toward confusion, disorder, and disaggregation, folding the adversary "back inside himself," as Boyd termed it.<sup>18</sup> The objective is to isolate and divide, creating "many noncooperative conflicting centers of gravity [that] paralyze [the] adversary by denying him the opportunity to operate in a directed fashion."<sup>19</sup> This is very different than conventional planning wisdom, which advocates for attacking the centers of gravity through direct or indirect means.<sup>20</sup> Boyd notes that we might, additionally, attack connections *between* centers of gravity, not just the COGs themselves.

In each of the conditions, recovering is more difficult and time-consuming. Left unchecked or propelled with further momentum, one leads to the next in an effects spiral. Each represents a higher state of disruption, beginning with mere uncertainty and doubt and ending with panic and chaos. An effect could be targeted to cause a particular state, but more likely it will be the combination of multiple effects that begins and accelerates the cycle. The cascade of compounded effects is more than simply multiple effects added together.

Each of these states is based fundamentally on perception, compared to physical reality. To Boyd, perception was comprised of shifting *observations* and feedback, interpreted through *orientation*—itself a variable blend of cultural traditions, previous experience, new information, analysis, synthesis, and genetic heritage.<sup>21</sup> This led to *decision*, which enabled one to *act*. As the author has noted elsewhere, this tempo-based approach to conflict and war is a fundamental shift from an attritional approach, and it depends on viewing the opponent as a system of systems.<sup>22</sup>

As Carl von Clausewitz and Napoléon Bonaparte reminded us, moral fac-

tors are the ultimate determinants in war, and this gets at the essence of an overarching theme within Boyd's presentations—the need to drive the opponent or adversary toward a state of disaggregation, what he characterized ultimately as panic and chaos.<sup>23</sup> Boyd termed this moral conflict, and its essence, expressed in *Patterns*, was to, “[s]urface *fear, anxiety* and *alienation* in order to generate many non-cooperative centers of gravity as well as subvert those that adversary depends upon thereby magnifying internal friction” in order to “destroy moral bonds that permit an organic whole to exist.”<sup>24</sup>

For Boyd, these factors were seemingly even more important than physical effects, because the idea was to overwhelm the adversary's observation and orientation process that makes sense of (or orients to) environmental actions. The multiple thrust idea is inherent in the concept of what Boyd termed *nebenpunkte*, which Frans Osinga defined as taking “a line that threatens alternative objectives . . . distract[ing] the enemy's mind and forces” from the main effort, *schwerpunkte*.<sup>25</sup>

The temporal approach to war seeks to act before the opponent can properly orient in the OODA loop construct because they are forced to *re-observe, re-orient, re-decide, and react*. Therefore, rapid decision and compounding effects enable initiative, which can be defined as “the impulsive power resulting from timely decision and action, enabling freedom of maneuver while constraining an opponent's options.”<sup>26</sup>

Many observers believe that the temporal aspect in Boyd's conception is essential to achieving these effects.<sup>27</sup> However, time may also be conceived as a maneuver space, and going at a higher tempo may not always be the best approach—nor is a higher tempo necessary for seizing the initiative (consider an insurgent, operating at a slower tempo but achieving initiative in their chosen time scale, surviving beyond the conflict—a strategy of exhaustion).<sup>28</sup> Indeed, the most recent doctrinal publication, *Joint Planning*, Joint Publication (JP) 5-0, notes in the discussion of tempo, “on other occasions, JFCs [Joint Force Commanders] may find advantageous to conduct operations at a reduced pace.”<sup>29</sup> Ian T. Brown wrote similarly, concluding, “time and tempo were only two of the many factors used against an opponent to render him incapable of activity; one still sought to isolate and neutralize physical and non-physical strengths and moral bonds simultaneously.”<sup>30</sup> While Boyd did emphasize tempo, there is a tendency, as Frans Osinga noted, to equate speed with victory, especially with respect to decision making, but he argued for “dispelling the notion that mere information superiority or superior speed in command and control is the essence of the idea.”<sup>31</sup>

In the 1981 versions of “Patterns,” Boyd explained:

Impressions . . . we are trying to . . . get inside adversary system and mask own system against his penetration; create a variety of impressions of what is occurring and what is about to occur; generate mismatches between what seems to be and what is; push adversary beyond his ability to adapt.<sup>32</sup>

While tempo is important, it should not be confused with the goal of merely “out-speeding” the opponent.

As noted elsewhere, decision enables initiative, which conveys degrees of control.<sup>33</sup> While he never explicitly defines initiative, he does offer something that sounds strikingly similar without attaching it to the word “initiative”: “improve our capacity for independent action . . . diminish the adversary’s capacity for independent action, or deny him the opportunity to survive on his terms, or make it impossible for him to survive at all.”<sup>34</sup>

Ultimately, the effects spiral works because it operates against the strongest and weakest links in the system simultaneously—what we might consider the human domain.<sup>35</sup> Dr. Jeffrey Reilly has argued that the human domain is what multi- and all-domain actions seek to influence, comprised of leaders, organizations, and populations.<sup>36</sup> This resonates with Clausewitz’s emphasis on the moral and emotional aspects of warfare and with Marine Corps thinking about the nature of war. *Warfighting*, Marine Corps Doctrinal Publication 1, expresses the Marine view of war’s characteristics as uncertainty, fluidity, friction, disorder, complexity, violence, and danger; the interaction of physical, moral, and mental forces; its constantly evolving nature; and containing a human dimension, previously mentioned.<sup>37</sup>

## **The OODA Loop as a Complex, Adaptive System**

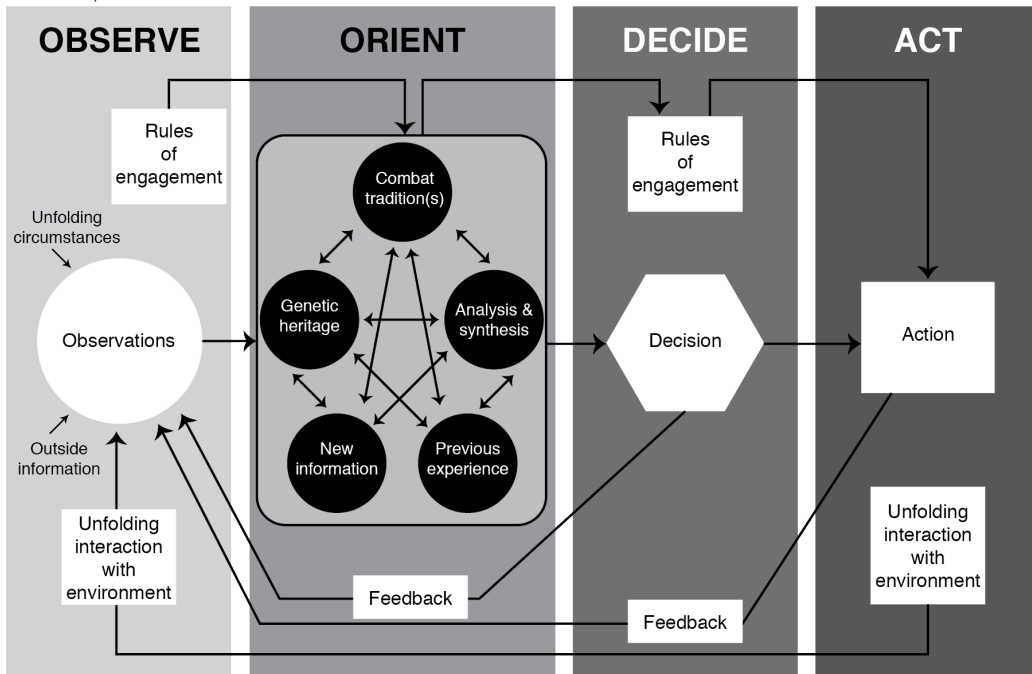
The OODA loop concept underwent significant development during the years of Boyd’s writing, progressing from the simple four-step process to a broader view of organizations and organisms.<sup>38</sup> These elements move the OODA loop from a simple heuristic to a more sophisticated model of organic interaction into complex, adaptive systems. As such, they will respond with any kind of interaction, but how they orient and understand will depend on a variety of feedback loops, aspects of orientation, and influences of what and how they observe—in addition to specific efforts at disinformation and deception, which can impact any connection point or points within the system.

## **Crafting the Environment**

In Boyd’s 1987 briefing, “Strategic Game of ? and ?,” he summarized the crucial importance of his “big theme” for three of his previous projects, which is “one of interaction and isolation.”<sup>39</sup>

Boyd saw manipulation of the environment as crucial to victory in states as diverse as full-scale blitzkrieg to guerrilla operations. In conflict, examined in “Patterns,” one seeks to create an environment of menace, which he defined as “impressions of danger to one’s well-being and survival.”<sup>40</sup> *Menace* is the state of being in danger, or the perception of being in danger, which begin the spiral. The Doolittle Raid on Tokyo might be taken as a classic example of an effort to begin the cycle, since it was not the relatively light physical destruction that was the point of the raid, but the psychological effect. It is an atmosphere of menace that energizes the spiral of disruption.

**Figure 1.** Boyd's expanded OODA loop, based on a 1992 sketch of the loop surviving in the Marine Corps Archives



Note the myriad connections within and between the observation and orientation segments—these are excellent points to inject disruption.  
Source: adapted by MCUP.

The idea as expressed in “Patterns” was to create the atmosphere of menace by eroding factors that contribute to cohesion, such as trust and confidence. The safe, comfortable world of the opponent must become amorphous and unpredictable, which creates a fundamental sense of insecurity, anxiety, and menace. In today’s multidomain and all-domain approaches, these effects are made, creating tangles across multiple domains simultaneously.<sup>41</sup>

At the same time, he saw that the inverse was true for protecting friendly centers of gravity. In “Organic,” he emphasized continual interaction between components, designed to redundantly reassess the changing environment in support of continual adaptation and evolution. It was the connections between elements that was crucial in “Organic,” just as it was the connections between components that it was necessary to challenge or sever in “Patterns.” Boyd summarized, “the strategic game is one of interaction and isolation.”<sup>42</sup>

### **Character of Modern Warfare and Engagements**

Today, the emergence of an effective “reconnaissance-strike complex,” blending pervasive surveillance (satellites, ubiquitous sensors, drones) with long-range fires (missiles, stealth, electronic warfare, fifth columns, drones), has created a moment in history when it seems that gathered forces face significant risk—a risk that increases sharply the longer they are gathered.<sup>43</sup>

Clausewitz's conception of a single center of gravity, "the hub of all power and movement," in his famous phrasing, seems to be a characteristic of a foregone era in warfare, at least at the operational level.<sup>44</sup> Indeed, today's COGs (or critical vulnerabilities) are as likely to be informational and economic as they are military and based on force or the threat of force, even at the operational level, because of ubiquitous connectivity and sensors. But this applies even for fielded forces, because of the danger to gathered forces, potently and disastrously experienced by both Taliban fighters and Russian soldiers, and reflected in current Marine Corps efforts to project power into the Pacific area of operations.<sup>45</sup> The characteristics of today's warfare suggest that forces within range of the opponent's long-range fires must be dispersed and mobile, evading detection through the enemy's reconnaissance-strike complex, gathering as briefly as possible to strike with as much speed and secrecy as possible, then dispersing again so long as they remain in range. This suggests that at the operational and tactical levels, multiple centers of gravity exist, a concept Boyd advocated as early as 1989, though he evinced a preference for "vulnerability" over "center of gravity."<sup>46</sup>

Because of their critical nature, centers of gravity are likely to be well defended. As examined above, one can attack the node and/or its connections. Economic and informational nodes may be undefended or defended by means other than the physical. Today's battlefield is connected ubiquitously through military and non-military connections, and without these connections, the disparate elements cannot effectively coordinate. One does not have to destroy; one can use the pallet of defeat mechanisms expressed in *Joint Planning* (destroy, dislocate, disintegrate, isolate, disrupt, degrade, deny, and neutralize) to attack the connections.<sup>47</sup> For example, degrading the quality of a connection by injecting disinformation could begin the spiral and might be well within operational reach, even if destruction of the connection is not—for example, if connection methods are redundant.

Engagements in today's warfare are likely to become what Cyber Command and Special Operations Command term as *persistent*.<sup>48</sup> Unlike the clashing, climactic engagements discussed by Clausewitz and Antoine-Henri de Jomini, much conflict in today's environment takes place across the competition continuum, as the Department of Defense terms it, competition below or hovering just around the threshold of traditional warfighting and dominated by independent economic and informational actors.<sup>49</sup> Because of this persistent engagement by cyber, Special Operations Forces, and informational forces, planting the seeds to be evoked later is common practice, a part of the competition landscape, encouraging commanders and planners to take on a wider vista and a longer-range view of time.

All of this may be seen in the recent Russia-Ukrainian war. Various operational centers of gravity have been identified by both sides that include fielded force concentrations, key leaders, and logistical and C2 hubs, alongside more traditional terrestrial objectives such as cities, bridges, and key terrain features.<sup>50</sup>



Information may be seen as the connective tissue binding centers of gravity within and between Russia and Ukraine, along with their respective allies and supporting partners. Economics might be seen similarly, playing an additional crucial role in terms of stamina and resilience. Persistent presence by both Western SOF forces and advisors such as the California National Guard have forged enduring relationships while preparing Ukraine for conflict.<sup>51</sup> On the Russian side, efforts to drive Ukrainian loyalists out of Crimea and the contested eastern regions, alongside persistent presence of Spetznaz, the Federal Security Service (FSB), Wagner Group, and other entities creates a narrative of its own as well as direct social, cultural, and political effects.<sup>52</sup>

### Using the Disruption Spiral

Following Boyd's strategic theory, as expressed across his multiple presentations discussed above, the objective is not to necessarily strike the enemy's centers of gravity directly but to attack the connections between the centers. Indeed, the term *center of gravity* implies a single center, whereas in postmodern warfare any target that may be seen may be struck with lethal and catastrophic force (for example, the Ukrainian HIMARS strike on the Russian barracks in Makiivka, 2022). Postmodern warfare is decentralized, coupled with the ability to rapidly synchronize and gather at the crucial place and time.

At the start of the spectrum, uncertainty can be the minimum effect one might seek in a disruption effort, and it is prevalent in both maneuver and moral style conflicts.<sup>53</sup> On his "Essence of Moral Conflict" slide, Boyd wrote, "*Uncertainty*—impressions or atmosphere generated by events that appear ambiguous, erratic, contradictory, unfamiliar, chaotic, etc."<sup>54</sup> Uncertainty draws from the thinking of Thomas Kuhn on paradigms and Werner Heisenberg with his uncertainty principle; injecting even just a little uncertainty into the opponent's decision cycle may result in a slight delay, which, given the nature of observe/orient, may result in a downward spiral unless counteracted by action taken to retrieve the initiative.<sup>55</sup> In an environment where time compresses toward Dr. Jeffrey Reilly's "OODA point," even a slight delay might be decisive.<sup>56</sup>

In this sense, a suboptimal action may well be better than no action—or the perfect action taken later—since even almost any action might recover the initiative and stop the spiral. Another word for uncertainty might be *ambiguity*, though it is worth noting that entities and individuals have vastly different tolerances for ambiguity, and in a mission-command environment, uncertainty as an effect alone might yield the opposite effect, encouraging creativity, innovation, and freedom of maneuver otherwise constrained by overcentralization.

Doubt is Boyd's next condition on the spiral. Doubt causes an even longer delay in the process of orientation, as information received or previously understood is questioned. In "Patterns," Boyd referred to it as a "moral factor," and he often associated it with fear and anxiety. In the section looking at success factors for blitzkrieg-type operations, he wrote, "broad use of [the] *Schwerpunkte* concept coupled with fast tempo/fluidity-of-action of armoured teams

and air support permit blitzers to repeatedly reshape strength and rapidly shift it against, or thru [sic], weaknesses thereby generate doubt and uncertainty which magnify into panic and chaos.”<sup>57</sup>

Extending further down the spiral, mistrust questions the fidelity of relationships or perceptions of fact. In planning terms, this can be a useful revisit of facts converted from assumptions, but in terms of resistance and cohesion, it acidly chews at the bonds critical for unity of effort. On his moral conflict slide, Boyd wrote, “Atmosphere of doubt and suspicion that loosens human bonds among members of an organic whole or between organic wholes.”<sup>58</sup> This does not only apply to fellow humans; it could equally apply to mistrust in key systems or processes. Osinga observed that eroding trust was a crucial element of Boyd’s presentation of guerrillas, forcing their opponents to work in “a hostile environment (of menace and uncertainty), which naturally breeds mistrust.”<sup>59</sup>

An entity within broken linkages leads to confusion, a state in which information flow is significantly interrupted, requiring a reorientation and realignment of key elements in order to regain cohesiveness. Boyd associated confusion with “contradiction of feeling, indecisiveness, panic,” which he arrived at by studying blitzkrieg tactics, Sun Tzu, and guerrilla warfare. Confusion was and is caused not only by fast tempo but *fluidity of action*, challenging further orientation. The object of confusion was to bring about disorder to “shatter cohesion, paralyze effort, and bring about adversary collapse.”<sup>60</sup>

Disorder results when confusion multiplies. The overall structure of an organization or organism begins to break down into component parts. Boyd often connected it with confusion in his presentations directly, repeated in the phrase, “confusion and disorder,” woven into the spiral with the goal of “present[ing] many (fast-breaking) simultaneous and sequential happenings” that make it hard for the enemy to respond in a “directed fashion.” In another instance, he wrote that confusion and disorder, “impedes vigorous or directed activity, hence, by definition, magnifies friction or entropy.”<sup>61</sup>

Fear grips individual components when the organization/organism breaks apart, because long-established relationships and stronger bonds yield to growing disruption, and the survival instinct begins to assert itself, eclipsing other concerns. As Osinga notes, Boyd followed J. F. C. Fuller that “a strategist should think in terms of paralyzing, not of killing . . . a man unnerved is a highly infectious carrier of fear, capable of spreading an epidemic of panic.”<sup>62</sup> Thus, fear is an accelerant along with the spiral, leading toward panic.

Panic ensues once fear rises to a point where analysis fails to hold disruption at bay and rational thought gives way to raw emotion. A particularly important form of panic is paralysis, the third option in the traditional fight-or-flight conception advanced by Dave Grossman in *On Killing*.<sup>63</sup>

Chaos reigns at the end of the spiral, where an organization (or organism) is fully disaggregated “back inside himself” and there is no cohesive relationship between the parts.<sup>64</sup> Chaos is the opposite of order or law; there should be no corporate will to resist in a state of chaos, though individual components may

still resist as their identity has fully shifted from being a part of the whole to being an individual with fundamental survival instincts.

### **Using the Spiral of Disruption**

One conducts operations in order to fold the adversary “back inside himself” and “maneuver [the] adversary beyond his moral-mental-physical capacity to adapt or endure so that he can neither divine our intentions nor focus his efforts to cope with the unfolding strategic design or related decisive stroke as they penetrate, splinter, isolate or envelop, and overwhelm him.”<sup>65</sup> Boyd relates that

unless such menacing pressure is relieved, [the] adversary will experience various combinations of uncertainty, doubt, confusion, self-deception, indecision, fear, panic, discouragement, despair, etc., which will further:

- Disorient or twist his mental images/impressions of what’s happening; thereby
- Disrupt his mental/physical maneuvers for dealing with such menace; thereby
- Overload his mental/physical capacity to adapt or endure; thereby
- Collapse his ability to carry on.<sup>66</sup>

All of this relates fundamentally not so much to observation by the opponent as it does to orientation and overwhelming not just perception but “sense-making,” as it is often termed in JADO/JADC2. Orientation, in Boyd’s conception, is a product of a variety of influences—cultural traditions, previous experience, and analysis and synthesis, among others. The idea is that the weak points are the connection points in the system, as expressed in Boyd’s expanded OODA loop illustration.

Within the JADO construct, the idea is to present the enemy with a “convergence of effects globally, across all domains, to consecutively or simultaneously present an adversary with multiple dilemmas . . . such dilemmas, when presented at an operational tempo that complicates or negates an adversary’s response, enable the joint force to operate inside an adversary’s decision cycle.”<sup>67</sup>

As the director of the Air Force’s Joint All-Domain Strategist (JADS) concentration, Dr. Jeffrey Reilly has noted that JADO “recognizes temporarily limited opportunities and deliberately exploits domain interdependencies through access or control of key segments of the domains.”<sup>68</sup> This strongly echoes Boyd’s intent to attack an adversary’s system at the weak points binding elements together, disrupting cohesion and leading to confusion and ultimately disaggregation.

By striking connections, Boyd sought to isolate key elements of the system, as when the Coalition air struck at C2 in the Gulf War, isolating the regime and individual units on the battlefield, which it can be seen clearly launched a

cycle that ended in disorder and chaos. At the very least, initiative was lost to the defending Iraqi forces.<sup>69</sup> Using Boyd's spiral of disruption can be done at all three levels of war: the tactical, operational (what Boyd termed *grand tactical*), and strategic.<sup>70</sup>

Tactically, it is certainly possible to achieve destruction of a whole defender. This tends to be the aim of the direct, battle-centric approach, and it can certainly work. But, following the tenets of Basil Liddell Hart and Sun Tzu, an indirect approach may be less costly (if slower, requiring more patience).<sup>71</sup> Injecting uncertainty and doubt and leveraging Clausewitz's concepts of fog and friction to inject ambiguity may start the spiral of doubt and mistrust that leads to panic/paralysis, disaggregation, and dissolution.<sup>72</sup> The greater the volume of uncertainty, doubt, and mistrust injected simultaneously, the greater the probable rate of slide toward disorder, fear, panic, and chaos.

The larger and more complex an organism, the more likely it will be that resilience will remain with multiple redundant connections connecting key nodes and systems. If the culture enables mission-type command and encourages creative problem solving by educated individuals, resilience will be greatly enhanced. At the operational level, it becomes increasingly difficult and costly to destroy the whole entity, so attacking an entity at its key points of connection may represent a quicker way to leap straight to disorder, injecting more fear, resulting in panic and chaos. From Boyd's perspective, identifying and striking key connections is the best approach while Warden might argue that striking key nodes is a better approach.<sup>73</sup> This strongly implies a multiple COG model would yield the best analysis, rather than a single-center of gravity approach.

In today's world, increasingly, combined forces that multiply joint and all-domain approaches represent a key friendly center of gravity that must be defended. Given that trust is the key bond, the durability of long-term relationships based on shared strategic goals and risk must underpin such relationships and provide "moral strength," in Boyd's conception.<sup>74</sup>

At the strategic level, the scale of an organism suggests that destruction may well be out of reach, short of a nuclear or biological strike—anathema and fortunately likely unavailable. When dealing with an entity on a national scale, multiple redundant pathways and nodes again suggests a multiple center of gravity approach, underscoring the exceedingly difficult task of understanding the opponent at a level sufficient to identify key connection vulnerabilities.

This is especially difficult given the tendency to mirror and project one's own perceptions and conceptions on a thinking opponent. The triangulation of sources of subject matter expertise is one way to mitigate this risk, though it is very hard to do given the pace of most planning teams.

In an alliance, as with combined action, eroding trust is a time-tested way to reduce unity, as with the Iraqi efforts to inject wedges between the Arab states and the West using Scuds in an attempt to draw Israel into the war.<sup>75</sup>

## **Conclusion**

The list of effects proposed by Boyd—uncertainty, doubt, mistrust, confusion, disorder, fear, panic, and chaos—can be used as an effects spiral to create and measure effects in the human domain.<sup>76</sup> For a relatively low cost, one can inject uncertainty or doubt, causing mistrust and confusion and ultimately disorder, fear, panic, and chaos. Through a deliberate combination of physical and informational attacks, each condition leads to the next, serving to progressively isolate centers of gravity so they cannot coordinate and synchronize. In the interlocked and networked modern world, bypassing well-defended centers of strength to strike at an enemy's cohesion through their nodal connections may prove both efficient and effective. And against a peer or near-peer opponent, they may be all that is available in a crisis, or in the case of rapidly eroded fielded forces.

Ultimately, the point on the scale where an individual, an organization, or a leadership team ends up will depend, in part, on the target's resilience, as a function of culture, technology, supply, training, and education when compared to the strength, unexpectedness, and variability of the attack. Reducing the capacity and speed of decision making, or the quality of information available, can be done through both physical and informational means. This approach is valuable at all levels of planning and in all types of conflict, though like all tools, it must be used appropriately; there is no one size or one solution fits all—adaptability and tolerance for ambiguity, however, are crucial. Building an educated force, an energized, flexible set of organizations and individuals that can tolerate ambiguity while maximizing information superiority, is a formula for building a force likely to survive and dominate. Emphasizing human factors alongside technological superiority is a must; neither technology nor human factors can dominate alone in emerging forms of warfare, where physical distances have dramatically increased while the distance between human minds has shrunk.

## **Postscript: Inoculating against Uncertainty and Doubt**

In Boyd's conception, each of the above aspects represents a fundamentally human condition, though each applies also to technological proxies. As human conditions, they are countered by aspects that yield confidence—such as training, a strong esprit de corps, and experience. The West's professionalized armed forces do well with these aspects. But Boyd's spiral also suggests that a clever opponent will try to inject ambiguity and doubt into the cycle—and while coherence expressed through a strong organizational culture (esprit de corps) is helpful in countering it, Western military organizations are not as good at education. Education offers a broader set of adaptable tools and a realization that the world is a much larger place than training normally assumes, yielding tolerance for ambiguity and providing some inoculation of an individual or organization against uncertainty. Education prepares one for the unknown, versus training, which prepares for what is known based on best practices, because education tends to be open-ended and open whereas training is often a closed

system. In Boyd's terms, one cannot survive and adapt without openness and change, because the world constantly changes. Education offers cross-domain knowledge that can be exceedingly useful in developing approaches to wicked problems.<sup>77</sup> To realize the benefits of planning, response, and strategy, Boyd argued:

By an instinctive see-saw of analysis and synthesis across a variety of domains, or across competing/independent channels of information[, one must] . . . spontaneously generate new mental images or impressions that match up with an unfolding world of uncertainty and change.<sup>78</sup>

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## Endnotes

1. John R. Boyd, briefing slides, "Organic Conception for Command and Control," 1987, copy in the author's collection, slide 7; available also in John R. Boyd, *A Discourse on Winning and Losing*, ed. and comp. Grant T. Hammond (Maxwell AFB: Air University Press, 2018), 217–44.
2. Charles C. Krulak, "Letter to the Editor," *Inside the Pentagon*, 11 March 1997, author's collection.
3. This is not to imply that agreement with the OODA loop is universal; though widely accepted, challengers include Stephen Robinson, *The Blind Strategist: John Boyd and the American Way of War* (Dunedin, New Zealand: Exile Publishing, 2021). Nonetheless, the OODA model is widely accepted and is a foundational element of the Joint all-domain command and control (JADC2) architecture, as noted in the unclassified architectural graphic and in the U.S. Air Force's "USAF's Operating Concept for Information Warfare," 30 March 2022, author's collection.
4. For the best treatment of Boyd's ideas in their scientific and military context, see Frans P. B. Osinga, *Science, Strategy and War: The Strategic Thinking of John Boyd* (New York: Routledge, 2006); and John Andreas Olsen, ed., *Airpower Reborn: The Strategic Concepts of John Warden and John Boyd* (Annapolis, MD: Naval Institute Press, 2015). For a hagiographic but insightful biography from the perspective of the Defense Reform Movement, see Robert Coram, *Boyd: The Fighter Pilot Who Changed the Art of War* (New York: Little, Brown, 2005). For a less hagiographic but also less detailed treatment, focused more on Boyd's ideas, see Grant T. Hammond, *The Mind of War: John Boyd and American Security* (Washington, DC: Smithsonian, 2001). For a strongly argued critique of Boyd's work, particularly his use of history, see Robinson, *The Blind Strategist*. For the author's own treatment, Brian R. Price, *Eagles, Falcons & Warthogs: Gen. "Bill" Creech, Col. John Boyd and the Struggle to Remake the Tactical Air Forces in the Wake of Vietnam* (Annapolis, MD: Naval Institute Press, forthcoming).
5. For an excellent summary of Boyd's contribution to maneuver warfare, see Ian T. Brown, *A New Conception of War: John Boyd, the U.S. Marines, and Maneuver Warfare* (Quantico, VA: Marine Corps University Press, 2018), <https://doi.org/10.56686/19780997317497>.
6. For an expansion and an excellent summary, see Frans P. B. Osinga, "The Enemy as a Complex, Adaptive System: John Boyd and Airpower in the Postmodern Era," in *Airpower Reborn: The Strategic Concepts of John Warden and John Boyd*, ed. John Andreas Olsen (Annapolis, MD: Naval Institute Press, 2015), 48–92.
7. Carl von Clausewitz, *On War*, trans. Peter Paret and Michael Howard (1832; repr., Princeton, NJ: Princeton University Press, 1984), 184. "Another reason for not placing moral factors beyond the scope of theory is their relation to all other so-called rules. The effects of physical and psychological factors form an organic whole which, unlike a metal alloy, is inseparable by chemical process." First articulated in the interwar period

- by the Air War Plans Division, in the strategic bombing plan for Germany (AWPD-1). See Howard David Laine, "AWPD-1: America's Pre-World War II Plan for Bombing Germany" (master's thesis, Virginia Polytechnic Institute and State University, 1991). For industrial web theory as part of the U.S. Army Air Corps Tactical School's approach, see for example Brian D. Laslie, *Architect of Air Power: General Laurence S. Kuter and the Birth of the U.S. Air Force* (Lexington: University Press of Kentucky, 2017), 32; Scott F. Murray, *The Moral and Ethical Implications of Precision-Guided Munitions* (Maxwell AFB: Air University Press, 2007), 11–13; and Robert A. Pape, *Bombing to Win: Air Power and Coercion in War* (Ithaca, NY: Cornell University Press), 62–63.
8. For Boyd's extensive use of scientific, psychological, and philosophical literature, see especially Osinga, *Science, Strategy, and War*, chaps. 3 and 4, 52–127.
  9. John Warden's thinking on targeting developed over time, beginning with discussions on key targets in his 1988 work, *The Air Campaign* (Washington, DC: Potomac Books, 1988), 6, which flows into a discussion of centers of gravity. By the time he was articulating his "five rings" theory, articulated later that year in "Global Strategy Outline" (unpublished, see Olsen below, bibliography), he posited that "simultaneous attacks . . . launched against multiple target-sets within each of the five rings [leadership, C2, infrastructure and industry, population and agriculture, fielded forces], the effect would be exponential," as summarized by John Andreas Olsen in *John Warden and the Renaissance of American Air Power* (Washington, DC: Potomac Books, 2007), 110. As Osinga notes, Boyd sought to "isolate an opponent [or node] and in due course it will lose internal cohesion and external support, its delayed and misinformed reactions will be ineffective, and it will fail to adjust correctly to the changed environment." Osinga, *Science, Strategy, and War*, 72. Recently, Ian T. Brown summarized it this way: "Boyd characterized moral conflict as a style of warfare that sought to deliberately fray or sever those bonds in a way that reduced an opponent to a chaotic assortment of frightened, mistrustful, and isolated individuals [again, one could also read 'nodes']"; and Brown, *A New Conception of War*, 110.
  10. John Boyd, "Patterns of Influence," 1989, transcribed in Brown, *A New Conception of War*, 228. One of Brown's superb contributions to those seeking to understand Boyd's ideas is the "Patterns of Conflict" briefing transcription, since only a very few recordings of his briefings are known.
  11. The idea of "critical vulnerability" has a specific doctrinal meaning, used in critical factor analysis as a central method to analyze enemy centers of gravity (COGs) in Joint planning doctrine. See *Joint Planning*, Joint Publication 5.0 (Washington, DC: Department of Defense), GL-7, where a critical vulnerability is defined as "an aspect of a critical requirement which is deficient or vulnerable to direct or indirect attack that will create decisive or significant effects." For critical factor analysis, see Dale Eikmeier, "Logical Method of CoG Analysis," *Military Review*, September–October 2007, 62–66, where Eikmeier adds to the doctrinal definition, "The smaller the resources and effort applied and the risk and cost, the better." At least by 1995, as expressed in the Quantico presentation cited in note 10, Boyd preferred the term vulnerability to center of gravity; see the exchange between Boyd and an unidentified colonel in Brown, *A New Conception of War*, 217–18. In fact, doctrinal acceptance of the ideas of critical factor analysis was suggested in 1989 by Capt John Schmitt as author of *Marine Corps Operations*, Marine Corps Doctrinal Publication 1, just published at the time of Boyd's "Patterns of Conflict" seminar at Quantico. Schmitt argued, "we should focus our efforts against a critical enemy vulnerability," a fundamental tenet of maneuver warfare theory as expressed in MCDP-1 in both 1989 and 1997.
  12. John Boyd, "Patterns of Conflict," 1989, 213.
  13. Osinga, *Science, Strategy, and War*, 1–2.
  14. Boyd, "Patterns," slide 175, "The Game is to. . . Pull adversary apart, produce paralysis, and collapse his will to resist," reprinted in Brown, *A New Conception of War*, 249, cited also multiple times in Osinga, *Science, Strategy, and War*.
  15. Boyd, "Organic Conception of Command and Control," in *A Discourse on Winning and Losing*, 217–54.

16. *Nebenpunkte* as a concept appears 15 times in Boyd's September 1981 version of "Patterns of Conflict." In the 1989 "Patterns" briefing transcribed by Ian T. Brown, it appears only once, in the summary on slide 175 (249), though this is only a published excerpt of a full transcription. Osinga explains the concept: "If you take a line of distraction that threatens alternative objectives . . . an idea Boyd was to come to refer to as *Nebenpunkte*." *Science, Strategy, and War*, 35. This idea forms a core part of conceptions of multi- and all-domain operational concepts. For the U.S. Army, this was expressed clearly in "The U.S. Military in Multi-Domain Operations," TRADOC Pamphlet 525-3-1, 2018. "Long range ground fires complicate enemy defenses by forcing the enemy to react to multiple forms of attack simultaneously against a number of different systems for which it does not have an effective counter," 33. The Air Force's Joint All-Domain Strategist (JADS) concentration approach—roughly equivalent of the Army's SAMS—is built around the synchronization of all-domain operations to achieve simultaneous effects.
17. Osinga, *Science, Strategy, and War*, 159.
18. Boyd, "Patterns of Conflict," 1989, slide 141, 244.
19. Boyd, "Patterns of Conflict," 1989, 215.
20. *Planning*, iv–22. In *Planning*, the importance of COGs is described: "Success requires protecting the friendly COGs while defeating the enemy COG."
21. Boyd's OODA loop sketch, 1996 version from "The Essence of Winning and Losing," 28 June 1995, rev. 1996.
22. Brian R. Price, "In Pursuit of Decision Advantage in JADO/JADC2: Conceptual Background & Definitions," *Aether* (forthcoming).
23. In *On War*, Clausewitz states, "Material activity is never directed against material force alone; it is always aimed simultaneously at the moral forces which give it life, and the two cannot be separated," 137. Additionally, he states, "We must return once more to this subject, already touched upon in Chapter Three of Book Two, since the moral elements are among the most important in war," 184. Napoléon's dictum of "the moral is to the physical three to one" appears in Boyd's presentations, but without specific attribution.
24. Boyd, "Patterns of Conflict," 1981, slide 113. Note: the author has chosen to smooth a few of Boyd's phrasings in terms of adding articles and occasional punctuation.
25. Osinga, *Science, Strategy, and War*, 35 and 154. Boyd defined this clearly in "Patterns of Conflict," 1981: "Employ *Cheng/Nebenpunkte* as basis to repeatedly tie-up, divert, stretch-out, or drain-away adversary attention and strength in order to expose vulnerabilities and weaknesses for decisive stroke(s) by *Chi/Schwerpunkt*," 132.
26. Price, *Decision Advantage*.
27. Steven Metz, "The U.S. military will be the first post-modern state combatant, attaining greatly amplified speed and precision by the integration of information technology and development of a system of systems which link together methods of target acquisition, strikes, maneuver, planning, communication and supply . . . time will be the key element. Postmodern militaries will use speed and knowledge to bring the conflict to a quick resolution." Cited in Osinga, *Science, Strategy, and War*, 251.
28. Price, "Time as a Domain," *Over the Horizon* (blog), forthcoming.
29. *Joint Planning*, Joint Publication 5-0 (Washington, DC: Department of Defense, 2020), iv–36, where the full paragraph attempts to address the need for nuance in discussing time: "The tempo of warfare has increased over time as technological advancements and innovative doctrines have been applied to military operations." One may think of the Taliban or Ukrainian defending forces seeking to draw out the tempo of a campaign to seek exhaustion rather than attrition. *Joint Planning* continues: "In many situations, JFCs may find it advantageous to maintain an operational tempo that stretches the capabilities of both friendly and enemy or adversary forces. On other occasions, JFCs may find it advantageous to conduct operations at a reduced pace. During selected phases of a campaign, JFCs could reduce the pace of operations, frustrating enemy or adversary commanders while buying time to build a decisive force or tend to other priorities in the OA such as relief to displaced persons. During other



- phases, JFCs could conduct high-tempo operations designed specifically to overwhelm enemy defensive capabilities.”
30. Brown, *A New Conception of War*, 144.
  31. Osinga, *Science, Strategy, and War*, 177.
  32. Boyd, “Patterns of Conflict,” 1981, slide 120.
  33. Price, *Decision Advantage*.
  34. Boyd, “Strategic Game of ? and ?,” slide 14.
  35. *Warfighting*, Marine Corps Doctrinal Publication 1 (Washington, DC: Headquarters Marine Corps, 1997), presents a less comprehensive view of what the authors term the “human dimension.” The concept of a human domain better characterizes the impact of humans, even on a technologically advanced battlefield, as central.
  36. Jeffrey M. Reilly, “Multi-Domain Operations” slide, multiple briefings, author’s collection. Reilly’s conception features the overriding importance of control over the electromagnetic spectrum (EMS), with cyber as a subset of EMS that enables space, air, maritime, and land operations, all working to influence the human domain. The Joint-All Domain Strategist approach taught within the SAMS-like concentration at Air Command & Staff teaches students to recognize and attack “temporally limited opportunities . . . [to] exploit domain interdependencies through access or control to key segments of the domains.” *Joint All-Domain Strategist (JADS) Planning Guide* (Maxwell AFB: JADS, 2020), 1. Note how this is different from Boyd’s idea of attacking connections between organic elements of the system as a whole—the JADS method focuses on disrupting fielded forces and command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) to influence leaders, organizations, and populations, a much more operationally focused expression of this closely related idea.
  37. *Warfighting*, 5–18. The human dimension appears on 13–14, but it focuses more on the effect of will, noting however that it is central in war. In today’s operations, because of ubiquitous connectivity, the author would argue that the human dimension is even more encompassing and crucial, with emotive factors such as narrative and identity overshadowing traditional intellectual factors such as interest calculation and cost-benefit analysis. Therefore, establishing an action’s narrative as expressed to and as seen by key audience segments requires deep knowledge of key segments, their beliefs, and how clashes are interacting with other perspectives in real time. This in turn requires knowledge of and access to those same segments, a major challenge for policy makers, planning staffs, commanders, and those charged with what we today term, imprecisely, “information operations.” All of this forms part of the human domain, in addition to leaders, organizations, and populations. As any marketer knows, segmenting the market and developing a deep understanding of each segment is the key to success.
  38. One needs only compare the very simple four-step articulation of the OODA loop replicated countless times in military and business literature (observe, orient, decide, act) and the far more complex model shown far less frequently, which takes into account the elements of systems theory and complexity in the form of key feedback loops and conceptual lenses through which all actions are viewed, key in the orientation phase. For the fundamental articulation of Boyd’s OODA loop, see his 1981 discussions of the loop in “Patterns of Conflict”; for the full model, see Boyd, “A Discourse on Winning and Losing,” June 1995, slide 4. Frans Osinga discusses the distinctions between the simple tempo-based OODA loop and the nuanced, uncertainty-seeking approach as his central theme in chapter 7 of *Strategy, Science, and War*, 234–57. See also Daniel H. Abbot, “A History of the OODA Loop,” in *The John Boyd Roundtable: Debating Science, Strategy, and War*, ed. Mark Safranski et al. (Ann Arbor, MI: Nimble Books, 2009), 1–5.
  39. Boyd, “Strategic Game of ? and ?,” slide 30.
  40. Boyd, “Patterns of Conflict,” 1981, slides 19, 35, 104, 111, 113–14, 117, 121, esp. 113–14.
  41. There are myriad examples, but a good expression may be found in the Air Force’s *Department of the Air Force’s Role in Joint All-Domain Operations*, Air Force Doctrinal

- Publication 3-99 (Maxwell AFB: Department of the Air Force, 2021), “success requires the convergence of effects globally, across all domains, to consecutively or simultaneously present an adversary with multiple dilemmas,” 1.
42. Boyd, “Strategic Game of ? and ?,” slide 33.
  43. Justin Bronk, “The Impact of Reconnaissance Strike Complex on Ground Maneuver,” RUSI, 15 June 2021, YouTube video, 35:57.
  44. Clausewitz, *On War*, 485. At the strategic level, the will of the population and/or leadership and key organizations is often thought to be the COG, depending on a number of factors, such as government and communications infrastructure. Even Clausewitz noted the conception of an opponent as a kind of organic entity, where cohesion was crucial, “in war as in the world of inanimate matter the effect produced on a center of gravity is determined and limited by the cohesion of the parts,” 486.
  45. “Airstrikes Target Taliban Location Disclosed in Social Media, Leaving Several Dead,” Khaama Press, 18 March 2019; Derek Eaton et al., *Supporting Persistent and Networked Special Operations Forces (SOF) Operations: Insights from Forward-Deployed SOF Personnel* (Santa Monica, CA: Rand, 2017), <https://doi.org/10.7249/RR1333>; “Persistent Engagement” (CyberCom capabilities and operational approach briefing to the Joint All-Domain Strategist class of 2022, UNCLASSIFIED slide 4, Maxwell AFB); Jeff Schogol, “Russian Soldier Gave Away His Position with Geotagged Social Media Posts,” *Task and Purpose*, 3 January 2023; and *Tentative Manual for Expeditionary Advanced Base Operations* (Washington, DC: Headquarters Marine Corps, 2021).
  46. “Patterns of Conflict,” 1989, 217–18.
  47. *Joint Planning*, iv-41–iv-42. Note that the coherency of this model has been challenged by colleagues Ann Mezzell and Wes Hutto, “Bridging the Gap: Military Strategy in Theory and Doctrine,” draft, December 2022.
  48. Derek Eaton et al., *Supporting Persistent and Networked Special Operations Forces (SOF) Operations*; and “Persistent Engagement.”
  49. *Joint Operations*, v-1–v-8. This edition of *Joint Operations* builds on the earlier “Joint Concept of Integrated Campaigning” (JCIC), dating from 2018. The 2022 *Joint Operations* integrates much of the JCIC’s content and shifts the emphasis on operations for the joint force from contingency planning to campaign planning and globally integrated operations.
  50. Olafimihan Oshin, “US Has Helped Ukraine Target Russian Generals: Report,” *Hill*, 4 May 2022; “Ukrainian Forces Target Four Russian Concentrations of Troops, Equipment in the South,” *Kyiv Independent*, 5 January 2023; David Axe, “Ukraine’s Missiles Are Blowing Up Russian Supply Hubs—Some Inside Russia,” *Forbes*, 27 June 2022; and Yaroslav Trofimov, “Ukraine Targets Key Bridge as It Prepares Counteroffensive in South,” *Wall Street Journal*, 20 July 2022.
  51. William Leasure, “U.S. Special Operations Forces Train with Ukrainian Counterparts,” Department of Defense, press release, 25 July 2017; and Jim Garamone, “Ukraine-California Ties Show Worth of National Guard Program,” press release, Department of Defense, 18 March 2022.
  52. Paul Waldie, “How Ukrainian Loyalists Are Bearing the Brunt of Russia’s Intervention,” *Global and Mail*, 6 March 2014; Yevgeny Prigozhin, “Ukrainian Army Reportedly Attacks Wagner Mercenary Base in Occupied Donbas,” Yahoo! News, 2 January 2023; Tor Bukkvoll, “Russian Special Operations Forces in Crimea and Donbas,” *Parameters* 46, no. 2 (2016): <https://doi.org/10.55540/0031-1723.2917>; and Serhey Hayday, “Ukrainian Military Carried Out a Precision Strike on Wagner Base at Stadium in Kadiivka, Luhansk, Governor Says,” *New Voice of Ukraine*, 10 June 2022.
  53. Boyd, “Patterns of Conflict,” 1981, slide 103.
  54. Boyd, “Patterns of Conflict,” 1981, slide 113; and 1987 version, slide 122.
  55. For Kuhn’s influence on Boyd, see Michael Loh, oral history interview with Brian R. Price, 15 and 31 January 2018, 4–5, author’s collection. Gen Loh was a longtime associate of Boyd’s. For Kuhn and Heisenberg, see Frans. P. B. Osinga, “John Boyd and Airpower in the Postmodern Era,” 56, 64, 74.
  56. In Dr. Reilly’s conception, the “OODA Point” is the point at which available decision

- time becomes so short as to be impossible without the aid of artificial intelligence. Jeffrey M. Reilly, "OODA Point: The Need for an Airman's Approach to Operational Design" (working paper, Air Command & Staff College, Maxwell AFB, November 2020).
57. Boyd, "Patterns of Conflict," 1981, slide 80. As noted in note 5 above, Boyd's use of history was profoundly influenced by the writings of Basil Liddell Hart and the memoirs of World War II German generals, which have been characterized by recent historians as inaccurate. Critics such as Stephen Robinson, writing in *The Blind Strategist: John Boyd and the American Way of War*, challenge Boyd's interpretation of how the Germans succeeded at the operational level, and based primarily on this critique, challenges the OODA loop and the whole of maneuver warfare.
  58. Boyd, "Patterns of Conflict," 1981, slide 113.
  59. Osinga, *Science, Strategy, and War*, 170.
  60. Boyd, "Patterns of Conflict," 1981, slides 90, 113, 126–27.
  61. Boyd, "Organic Conception of Command and Control," slide 20.
  62. Osinga, *Science, Strategy, and War*, 34.
  63. Dave Grossman, *On Killing: The Psychological Cost of Learning to Kill in War and Society* (1995; repr., New York: Open Road Media, 2009), see especially chapter 2.
  64. Boyd, "Organic Conception of Command and Control," slide 7.
  65. Boyd, "Patterns of Influence," 1981, slide 144.
  66. Boyd, "The Strategic Game of ? and ?," slide 44.
  67. *The Department of the Air Force's Role in Joint All-Domain Operations*, Air Force Doctrinal Publication/Space Doctrinal Publication 3-99 (Washington, DC: Department of the Air Force, 2021), 1.
  68. Jeffrey M. Reilly, "JADO Briefing," slide 4, "Continuum of Domains," October 2020, unclassified, author's collection.
  69. Note that the Iraqi example is interesting also because the Iraqis believed they had seized the initiative even using a defensive posture, because they hoped to lure the allied forces into attacking into the teeth of the defenses, weakening the force and allied resolve. In Joint doctrine, the offense is often equated with initiative, but this may represent a flawed understanding of initiative; it should be seen not equivalent to offense, but the power to reduce the opponent's options while maximizing one's own—it is the motive power to make something happen. This can be done on offense or defense. See Price, "Decision Advantage," forthcoming.
  70. Boyd, "Patterns of Conflict," 1981, slides 39, 46, 60, 78, 82.
  71. Basil Liddell Hart's classic work, *Strategy* (New York: Praeger, 1954). For Sun Tzu, although there are many translations, the author is grateful to colleagues and friends Drs. Robert Kerr and John Minney for alerting me to a phenomenal and nuanced translation, *Sun Zi Art of War: An Illustrated Translation with Asian Perspectives and Insights*, trans. Chow-Hou Wee (Singapore: Pearson, 2003). As is evidenced by the inclusion of both within Boyd's "Patterns of Conflict" briefing slides, it is also widely recognized that he drew a great deal from both.
  72. Clausewitz, *On War*, "War is the realm of uncertainty; three quarters of the factors on which action in war is based are wrapped in a fog of greater or lesser uncertainty," 101.
  73. See notes 9 and 10.
  74. Boyd, "Patterns of Conflict," 1981, slide 111. Boyd "suggests that *moral strength* represents mental capacity to overcome menace and uncertainty."
  75. Norman Scharzkopf and Peter Petre, *It Doesn't Take a Hero: The Autobiography of General H. Schwartzkopf* (New York: Bantam, 1992), 416–17; and Richard P. Hallion, *Storm over Iraq: Air Power and the Gulf War* (Washington, DC: Smithsonian Books, 1982), 181–82.
  76. Interestingly, this may be even more important in the cyber realm. Current artificial intelligences and machine learning systems learn to deal with the expected; their tolerance for ambiguity varies, but when the circumstances exceed known patterns, responses can range from the unexpected to shut down.
  77. See especially David Epstein, *RANGE: Why Generalists Triumph in a Specialized World*

- (New York: Riverhead Books, 2019). For a summary and application, see Brian R. Price, “David Epstein’s RANGE—Specialization and Cross-Domain Problem Solving: What It May Mean for Education, Training, and Problem-Solving in the Armed Forces,” *Over the Horizon* (blog), 31 January 2022.
78. Boyd, “Strategic Game of ? and ?,” slide 58.