Victory Misunderstood

What the Gulf War Tells Us about the Future of Conflict

Stephen Biddle

The standard explanations of the Gulf War's outcome are wrong. The orthodox view explains the war's one-sidedness in terms of the Coalition's strengths, especially its advanced technology, which is often held to have destroyed the Iraqis' equipment or broken their will without exposing Coalition forces to extensive close combat on the ground.[1] The main rival explanation emphasizes Iraqi shortcomings, such as their weak morale, poor training and leadership, or numerical inferiority in the theater of war.[2] Both schools appeared within a few months of the cease-fire, and have changed surprisingly little since then.[3] The information

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1. See, e.g., William J. Perry, "Desert Storm and Deterrence," *Foreign Affairs*, Vol. 70, No. 4 (Fall 1991), pp. 66–82; Bobby R. Inman, Joseph S. Nye, Jr., William J. Perry, and Roger K. Smith, "U.S. Strategy After the Storm," in Joseph S. Nye, Jr., and Roger K. Smith, eds., *After the Storm: Lessons from the Gulf War* (New York: Madison Books for the Aspen Strategy Group, 1992), pp. 267–289; U.S. House Armed Services Committee, *Defense for a New Era: Lessons of the Persian Gulf War* (Washington, D.C.: U.S. Government Printing Office [U.S. GPO], 1992), hereafter cited as HASC, *Defense for a New Era*. Some have also explained the outcome in terms of superior Coalition military doctrine or strategic decision-making, or the training of Coalition troops, though these arguments have played a less central role. See, e.g., Lawrence Freedman and Efraim Karsh, *The Gulf Conflict, 1990–1991: Diplomacy and War in the New World Order* (Princeton, N.J.: Princeton University Press, 1993), p. 437; Norman Friedman, *Desert Victory: The War for Kuwait* (Annapolis, Md.: Naval Institute Press, 1991), pp. 235, 246, 252–253.

2. See, e.g., John Mueller, "The Perfect Enemy: Assessing the Gulf War," *Security Studies*, Vol. 5, No. 1 (Autumn 1995), pp. 77–117; Gregg Easterbrook, "Operation Desert Shill: A Sober Look at What Was Not Achieved in the War," *New Republic*, September 30, 1991, pp. 32ff; Michael J. Mazarr, Don M. Snider, and James A. Blackwell, Jr., *Desert Storm: The Gulf War and What We Learned* (Boulder, Colo.: Westview, 1993), pp. 113–117, 177–178.

3. Both originated in the extensive television coverage of the war, and the military briefings conducted during and shortly after the cease-fire. Among the earliest and most influential published versions of the orthodox technology explanation is Perry, "Desert Storm and Deterrence." Norman Schwarzkopf's famous observations on Saddam Hussein's strategic abilities were perhaps the earliest articulation of the "Iraqi shortcomings" school; see Easterbrook, "Operation Desert Shill."

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base on the war's conduct, however, has changed substantially with the recent appearance of the first detailed official and semi-official independent histories of the war.[4] This new information, combined with the results of counterfactual analysis using new computer simulation techniques, undermines both schools' conclusions.

To account for what is now known, and in particular, for new details on the conduct of the ground campaign, I propose a new explanation based partly on a combination of pieces taken from both camps' arguments—but mostly on a different conception of *how* technology and skill affected the outcome. That is, I argue that a synergistic interaction between a major skill imbalance and new technology caused the radical outcome of 1991. In the Gulf War, Iraqi errors created opportunities for new Coalition technology to perform at proving-ground effectiveness levels and sweep actively resisting Iraqi Republican Guard units from the battlefield. Without the Iraqis' mistakes to provide openings, however, the outcome would have been far different in spite of the Coalition's technology, and Coalition casualties would likely have reached or exceeded prewar expectations. But without the new weapons, mistakes like the Iraqis' would not have enabled the Coalition to prevail with the historically low losses of the Gulf War. Many previous armies have displayed combat skills no better than Iraq's, but without producing results anything like those of 1991; only a powerful interaction between skill imbalance and new technology can explain the difference.

This new explanation has important policy implications for net assessment, force planning, and the defense budget. Most current net assessment and force planning methodologies focus on the numbers and technical characteristics of the two sides' weapons.[5] By misunderstanding the role of skill in military outcomes, such methods risk serious misjudgment of states' real military power, and major errors in estimates of the forces needed to meet future threats. Similarly, arguments that modernization spending should be protected at the expense of training and readiness accounts overestimate the military value of technology per se, and underestimate the role of skill in determining the effects

4. See especially Eliot A. Cohen, Director, *Gulf War Air Power Survey* (Washington, D.C.: U.S. GPO, 1993), 5 vols. plus Summary Report, hereafter cited as *GW Air Power Survey*; Jesse Orlansky and Colonel Jack Thorpe, eds., *73 Easting: Lessons Learned from Desert Storm via Advanced Distributed Simulation Technology*, IDA D-1110 (Alexandria, Va.: Institute for Defense Analyses, 1992).

5. See, e.g., Paul K. Davis, ed., *New Challenges for Defense Planning: Rethinking How Much is Enough* (Santa Monica, Calif.: RAND, 1994); U. Candan et al., *Present NATO Practice in Land Wargaming*, STC-PP-252 (The Hague: SHAPE Technical Center, 1987); Wayne P. Hughes, Jr., ed., *Military Modeling* (Alexandria, Va.: Military Operations Research Society, 1984).

that any given technology will produce.[6] While it is always better to have both newer weapons and higher skills, choices must often be made, and it would be a mistake to pay for faster modernization by accepting a less skilled military.

More broadly, this new explanation also challenges perhaps the most sweeping legacy of the war: the new orthodoxy that we are embarked upon a "revolution in military affairs." This thesis holds that precision air and missile strikes will dominate future warfare, and that the struggle for information supremacy will replace the breakthrough battle as the decisive issue for success.[7] I argue that this view is based on a fundamental misreading of the war, and that a proper understanding implies a very different pattern for the conflicts of the future.

To make this case, I first specify the outcome to be explained. I next describe the new information sources on which my analysis of this outcome is based. I then outline briefly the main events of the war, with particular emphasis on the ground campaign, and on a case study of a particular ground engagement (the "Battle of 73 Easting"). From this, I identify a number of important discrepancies between the record of the ground fighting and the implications of the main current explanations of the war's outcome. I then develop my alternative theory, and show how it provides a more satisfactory explanation of what we now know of the war's conduct. Finally, I discuss the implications of that alternative for policy and for scholarship in international security affairs.

The War's Military Outcome and its Legacy

While the Gulf War's disappointing political outcome has received much recent attention, my focus is on its military results, and in particular, the Coalition's ability to prevail with a historically low loss rate.

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6. For arguments advocating protection of modernization accounts, see, e.g., Andrew Krepinevich, *The Bottom-Up Review: An Assessment* (Washington, D.C.: Defense Budget Project, February 1994), pp. 30–49; Daniel Goure, "Is There a Military-Technical Revolution in America's Future?" *Washington Quarterly*, Vol. 16, No. 4 (Autumn 1993), pp. 175–192, at pp. 188–190.

7. See, e.g., Andrew F. Krepinevich, "Cavalry to Computer: The Pattern of Military Revolutions," *National Interest*, No. 37 (Fall 1994), pp. 30–42, at p. 30; Alvin and Heidi Toffler, *War and Anti-War: Survival at the Dawn of the 21st Century* (Boston: Little, Brown and Co., 1993), p. 32; Michael J. Mazarr, Project Director, *The Military-Technical Revolution: A Structural Framework* (Washington, D.C.: Center for Strategic and International Studies, 1993), pp. 16–17; Commander James R. Fitzsimonds and Commander Jan M. Van Tol, "Revolutions in Military Affairs," *Joint Force Quarterly*, No. 4 (Spring 1994), pp. 24–31. This argument has gained an impressive range of adherents. See, e.g., Bradley Graham, "Battle Plans for a New Century," *Washington Post*, February 21, 1995, pp. 1ff; John Barry, "The Battle Over Warfare," *Newsweek*, December 5, 1994, pp. 27ff; Jeff Erlich, "One on

In less than six weeks, 795,000 Coalition troops destroyed a defending Iraqi army of hundreds of thousands, losing only 240 attackers.[8] This loss rate of fewer than one fatality per 3,000 soldiers was less than one tenth of the Israelis' loss rate in either the 1967 Six-Day War or the Bekaa Valley campaign in 1982, less than one twentieth of the Germans' in their blitzkriegs against Poland or France in 1939–40, and about one one-thousandth of the U.S. Marines' in the invasion of Tarawa in 1943.[9]

This unprecedentedly low loss rate came as a major surprise, despite great efforts before the war to predict losses. These efforts attracted many of the country's foremost scholars and policy analysts, and exploited the best available net assessment methods. The results were way off. All published results radically overestimated casualties: the best got no closer than a factor of three; the next best missed by a factor of six. The majority were off by more than an order of magnitude; official estimates were reportedly high by at least that much, while some official projections were reportedly off by more than a factor of 200.[10]

This unexpected and historically low loss rate has had important policy consequences. It has made the Gulf War a shaping event for defense planning in the 1990s in much the same way as the painful defeat in Vietnam came to shape U.S. planning in the 1980s. U.S. forces are now sized and structured against a Gulf War yardstick. New doctrines, weapons, and organizations are

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One: Interview with Secretary of Defense William Perry," *Defense News*, May 1–7, 1995, p. 38; "Deutch Gets Report Card Letter on the Revolution in Military Affairs," *Inside the Navy*, October 24, 1994, p. 11.

8. Of the troops, 540,000 (and 148 of the fatalities) were Americans. Freedman and Karsh, *The Gulf Conflict*, p. 409. The exact count of Iraqi troops and equipment in Kuwait is unknown, but the lowest current estimates are of multiple hundreds of thousands of troops, multiple thousands of armored vehicles, and at least tens of thousands of artillery pieces. See discussion below.

9. Anthony H. Cordesman and Abraham R. Wagner, *The Lessons of Modern War*, Vol. I (Boulder, Colo.: Westview, 1990), pp. 15, 18, 150; Larry H. Addington, *The Patterns of War Since the Eighteenth Century* (Bloomington: Indiana University Press, 1984), pp. 182, 184, 237; Phillip Karber et al., *Assessing the Correlation of Forces: France 1940*, BDM/W-79-560-TR (McLean, Va.: BDM Corp., 1979), pp. 2–3; George Bruce, ed., *Harbottle's Dictionary of Battles*, 3rd ed. (New York: Van Nostrand Reinhold, 1981), p. 95.

10. See, e.g., *Crisis in the Persian Gulf: Sanctions, Diplomacy and War, Hearings Before the Committee on Armed Services, House of Representatives*), House Armed Services Committee No. 101–57 (Washington, D.C.: U.S. GPO, 1991), pp. 448, 462, 463, 485, 917; "Defense Analysts: Limited War to Free Kuwait Could Cut Casualties by Over Half," *Inside the Army*, December 10, 1990, p. 11; "Air Strike on Iraq, the Favored Strategy, Means Big Risks for Both Sides," *New York Times*, October 23, 1990, p. A10. For reported prewar Defense Department estimates, see, e.g., Freedman and Karsh, *The Gulf Conflict*, p. 391; Michael Gordon and Bernard Trainor, *The Generals' War* (Boston: Little, Brown, 1995), pp. 132–133, 174; U.S. News and World Report, *Triumph Without Victory* (New York: Random House, 1992), pp. 129, 141; Bob Woodward, *The Commanders* (New York: Simon and Schuster, 1991), p. 349; Tom Matthews, "The Secret History of the War," *Newsweek*, March 18, 1991, pp. 28ff.

assessed in simulations of updated Gulf Wars. Acceptable casualty levels are judged against a 1991 benchmark.[11]

Before 1991, most planners expected future land wars to look like updated mid-century armored breakthrough battles, with air and missile forces playing mostly a supporting role by reducing the contestants' ability to push tanks forward into the decisive struggle at the point of attack.[12] Today, this traditional concept has almost disappeared, replaced by the new consensus that we are embarked upon a "revolution in military affairs" in which armored breakthroughs will be a thing of the past, and the struggle for information supremacy will be decisive. This sweeping policy legacy is a direct consequence of the extreme nature of the war's military outcome, and especially of the radically low Coalition loss rate. The reasons for this outcome are thus an important question for scholarship, and are my focus here.

New Sources of Information

My explanation of this outcome draws heavily on two new sources of information on the conduct of the war: the Gulf War Air Power Survey and the 73 Easting Project.[13]

The Gulf War Air Power Survey (GWAPS) is an independent analysis commissioned by the U.S. Air Force and modeled on the post–World War II Strategic Bombing Survey. The GWAPS staff had exceptional access to people

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11. See, e.g., Krepinevich, *The Bottom-Up Review*, pp. i, 22, 25–26, 49; Lawrence J. Korb, "The Impact of the Persian Gulf War on Military Budgets and Force Structure," in Nye and Smith, *After the Storm*, pp. 221–240; Inman, Nye, Perry, and Smith, "U.S. Strategy After the Storm," ibid., pp. 267–289, at p. 284; Representative Les Aspin, *An Approach to Sizing American Conventional Forces for the Post-Soviet Era: Four Illustrative Options* (Washington, D.C.: House Armed Services Committee, February 25, 1992); Christopher Bowie et al., *The New Calculus* (Santa Monica: RAND, 1993); Michael O'Hanlon, *Defense Planning for the Late 1990s* (Washington, D.C.: Brookings, 1995), e.g. pp. 30–32; Philip Finnegan, "War Emphasizes Stealth Need, Says Cheney," *Defense News*, February 11, 1991, p. 10; HASC, *Defense for a New Era;* John M. Collins, *Desert Shield and Desert Storm: Implications for Future U.S. Force Requirements* (Washington, D.C.: Congressional Research Service, 1991); Brigadier General Robert H. Scales et al., *Certain Victory: The United States Army in the Gulf War* (Washington, D.C.: Office of the Chief of Staff, U.S. Army, 1993), p. 364; Gordon and Trainor, *The Generals' War*, p. 470.

12. See, e.g., John J. Mearsheimer, "Numbers, Strategy, and the European Balance," *International Security*, Vol. 12, No. 4 (Spring 1988), pp. 174–185; Richard K. Betts, "Conventional Deterrence: Predictive Uncertainty and Policy Confidence," *World Politics*, Vol. 37 (January 1985), pp. 153–79; Seymour J. Deitchman, *Military Power and the Advance of Technology* (Boulder, Colo.: Westview, 1983).

13. I use these materials chiefly as data sources, from which I draw independent analytical conclusions with which neither project's staff might necessarily agree.

and information, and produced a detailed five-volume semi-official history of the air war.

The 73 Easting Project is a collaborative study conducted jointly by the independent Institute for Defense Analyses (IDA), the Defense Advanced Research Projects Agency (DARPA), and the U.S. Army. Its purpose was to develop a data base of unprecedented detail on the conduct of a single battle (the "Battle of 73 Easting"), then to use modern computer simulation technology to represent that data in a "virtual re-creation" of the minute-to-minute activities of each participating tank, armored vehicle, truck, or infantry team.[14] The resulting data provides an important resource in itself. But the unique strength of the 73 Easting analysis is the power that computer simulation provides to conduct controlled experiments by changing key characteristics of the historical event, then re-fighting the simulated battle and observing directly the effects on the putative outcome. This makes it possible to test alternative cause-and-effect hypotheses with especially thorough, systematic counterfactual analysis.[15]

Of course, simulation is not reality; as a counterfactual method, it cannot provide the realism of *ex post facto* observation of real events. A combination of simulation experimentation, deductive argument, and historical analysis by process tracing, however, compensates for the weakness of individual methods, and helps make the most of the available information base.

Overview of Events

The war began with a massive six-week air campaign. This quickly crippled the Iraqi air defense system and destroyed key elements of the Iraqi command

14. Data were collected using traditional documentary historical techniques, extensive engineering surveys of the battlefield immediately after the fighting, and exhaustive participant interviews, integrated using the simulation of the battle itself. Apparent discrepancies and data gaps were identified by representing all available information in the simulation and observing the results; these results were then shown to the participants in a three-dimensional, real-time visual display of the battle using the DARPA/IDA Simnet system. Simnet is a distributed network interconnecting large numbers of manned or unmanned individual-weapon simulators to create a single "virtual battlefield" on which the simulated weapons interact. It can be zoomed to follow individual combatants, or replayed as needed to review events in detail. Resolutions of contradictory or missing data were then worked out by the battle participants and the analytic team in light of all known information, entered into the data base, and the process repeated. See Orlansky and Thorpe, *73 Easting*, pp. I-65–I-79; II-1–II-118.

15. I use counterfactual analysis as one of two means to provide variance and to help avoid the danger of indeterminacy that can otherwise affect a study of a single war. The first of these is a sub-unit analysis breaking the war into battles, sectors, or unit frontages with varying charac-

and control network. There followed more than a month of effectively uncontested, round-the-clock pounding of ground targets across Iraq and over the entire depth of the Kuwait Theater of Operations (KTO).

As the air war unfolded, Coalition ground forces secretly redeployed from east to west. By February 23, the Coalition had positioned two corps on the Iraqis' extreme right flank. The Iraqis were disposed with 26 conscript infantry divisions deployed forward in a prepared defensive belt. Behind them were 9 higher quality Army mechanized divisions, with 8 elite Republican Guard divisions located well to the rear.[16]

The Coalition ground invasion began on the morning of February 24, when lead elements of two U.S. Marine divisions entered the Iraqi defensive belt near the coastal highway. The main effort, however, was on the far left, where the Coalition VII and XVIII Corps soon followed with a massive single envelopment of the Iraqi forward defenses. This "left hook" quickly collapsed the right wing of the Iraqi defensive belt, and opened a clear path across the Iraqi rear toward the Republican Guard.

Progress was rapid. Iraqi conscript infantry offered little resistance and surrendered in large numbers as Coalition forces overran the forward defenses. By February 26, Kuwait City had been reached, and three heavy divisions of the Coalition VII Corps were massed for a direct assault on the Republican Guard.

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teristics—in effect, changing the unit of analysis to create many separate events with varying properties. The second approach is to create variance experimentally via counterfactual simulations in which some properties of the historical battle are held constant while others are systematically varied. Taken together, these methods enable both a more incisive analysis of causation in the Gulf, and a better basis for drawing inferences from the experience of the Gulf to future wars under other conditions. The Army's Janus simulation was used for the counterfactual experiments discussed below because of its greater flexibility relative to Simnet and the reduced need for visual fidelity in counterfactual analysis. Janus is a stand-alone two-sided, interactive, stochastic combat simulation with resolution to individual weapon systems; for details, see Janus(A) 2.0 User's Manual (draft), Janus(A) 2.0 Model, prepared for the Department of the Army, HQ TRADOC Analysis Command ATRC-2D, Ft. Leavenworth, Kans., by TITAN Corporation, Ft. Leavenworth, Kans. On Janus' validity, see L. Ingber, H. Fujio, and M.F. Wehner, "Mathematical Comparison of Combat Computer Models to Exercise Data," *Mathematical and Computer Modeling*, Vol. 15, No. 1 (1991), pp. 65ff; L. Ingber, "Mathematical Comparison of Janus (T)," in S.E. Johnson and A.H. Lewis, eds., *The Science of Command and Control*, Part II (Washington, D.C.: AFCEA International Press, 1989), pp. 165–176. On theoretical indeterminacy and its avoidance, see Gary King, Robert O. Keohane, and Sidney Verba, *Designing Social Inquiry* (Princeton, N.J.: Princeton University Press, 1994), pp. 118–122, 220–221. On counterfactual analysis, see esp. James D. Fearon, "Counterfactuals and Hypothesis Testing in Political Science," *World Politics*, January 1991, pp. 169–195.

16. U.S. Department of Defense, *Conduct of the Persian Gulf War*, Final Report to Congress Pursuant to Title V of Public Law 102–25 (Washington, D.C.: U.S. GPO, April 1992), henceforth cited as DoD, *Conduct*, pp. 251–258.

Beginning on February 26, VII Corps drove through the Guard from west to east. Unlike the infantry at the border, however, the Guard fought back. By then the surviving Iraqis in the KTO were attempting to withdraw via Basra; perhaps three Guard and another three Army heavy divisions had been redeployed into blocking positions in an attempt to keep their retreat route open.[17] These units were in prepared defenses on familiar terrain, and the result was the heaviest fighting of the campaign as they met the Coalition's heaviest forces head on.

For some 41 hours, a series of battles was fought as VII Corps overran the Iraqi blocking force. Initial contact was made by the U.S. 2nd Armored Cavalry Regiment (ACR), which struck the Iraqi Tawakalna division on a stretch of mostly featureless desert near a map reference line called "73 Easting"; the ensuing engagement thus became known as the "Battle of 73 Easting." Advancing through a heavy sandstorm, the U.S. regiment was ordered to find the enemy, defeat any forward covering forces, determine the position and extent of the main defenses, and fix them in position for assault by the heavier forces advancing behind them. About 4 p.m. on the afternoon of February 26, the regiment's lead troop, under the command of Captain H.R. McMaster, made contact with the main Iraqi position.[18] Launching an immediate assault, McMaster's troop of 9 M1 tanks and 12 M3 Bradleys subsequently destroyed the entire defensive belt in front of them, hitting 37 Iraqi T-72s and 32 other armored vehicles in about 40 minutes. The adjoining troops immediately followed suit. Before stopping to regroup at around 5 p.m., this nominal scouting mission by three U.S. cavalry troops had overrun and wiped out an entire Republican Guard brigade. Subsequent Iraqi counterattacks were beaten off with heavy losses, leaving a total of 113 Iraqi armored vehicles destroyed at

17. These were the Tawakalna, Medina, and Adnan Republican Guard divisions, and the 52nd, 12th, and 10th Armored divisions; Scales, *Certain Victory*, pp. 232–236, 266; Richard M. Swain, *"Lucky War": Third Army in Desert Storm* (Ft. Leavenworth, Kans.: U.S. Army Command and General Staff College Press, 1994), pp. 244, 247; Gordon and Trainor, *The Generals' War*, p. 387; U.S. News, *Triumph Without Victory*, p. 335; Lieutenant Colonel Peter S. Kindsvatter, "VII Corps in the Gulf War: Ground Offensive," *Military Review*, February 1992, pp. 16–37, at 34.

18. U.S. armored cavalry regiments have three ground squadrons of three cavalry troops and one tank company each. Each troop is roughly equivalent to a reinforced tank or mechanized infantry company, and includes 20–30 armored vehicles. The three troops that fought at 73 Easting (G or "Ghost," E or "Eagle," and I or "Iron," as their radio call signs identified them) were assigned to two different squadrons (Ghost and Eagle in 2nd Squadron and Iron in 3rd). The Battle of 73 Easting per se thus pitted three U.S. cavalry troops (or less than half the 2nd ACR) against a brigade (the 18th) of the Tawakalna; Orlansky and Thorpe, *73 Easting*, pp. I-114, I-121–125.

the cost of one U.S. Bradley lost and one crew member killed by Iraqi fire (with a second vehicle loss attributed to fratricide). Some 600 Iraqi casualties were removed from the battlefield.[19]

The other actions followed a similar pattern. The largest of these, the Battle of Medina Ridge, pitted the 2nd brigade of the U.S. 1st Armored against the 2nd brigade of the Medina Luminous division. In 40 minutes of fighting, the U.S. brigade annihilated the Iraqi armor in place, took 55 Iraqis prisoner, and killed another 340. No U.S. casualties were suffered.[20] At Objective Norfolk, two battalions of the U.S. 1st Infantry division destroyed more than 100 armored vehicles of the Iraqi Tawakalna and 12th Armored divisions with the loss of two U.S. Bradleys.[21] In the Battle for the Wadi Al Batin, a battalion of the U.S. 3rd Armored division wiped out an Iraqi brigade, killing more than 160 armored vehicles while losing less than a half dozen of its own.[22]

By the morning of February 27, the Iraqi blocking force had been effectively wiped out. In all, VII Corps destroyed as many as 1,350 Iraqi tanks, 1,224 armored troop carriers, 285 artillery pieces, 105 air defense systems and 1,229 trucks. VII Corps itself, by contrast, lost no more than 36 armored vehicles to enemy fire, and suffered a total of only 47 dead and 192 wounded.[23]

Existing Explanations

What caused this result? The orthodox explanation focuses on Coalition strengths, and especially its superior technology. It holds that new surveillance, air defense suppression, stealth, and precision guidance systems gave Coalition aircraft total command of the skies and radical new lethality against Iraqi ground forces. This in turn enabled the Coalition to destroy the Iraqis' equip-

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19. Orlansky and Thorpe, *73 Easting*, pp. I-111 to I-136; Colonel Michael D. Krause, *The Battle of 73 Easting, 26 February 1991: A Historical Introduction to a Simulation* (Washington, D.C.: U.S. Army Center for Military History and the Defense Advanced Research Projects Agency [DARPA], August 27, 1991); J.R. Crooks et al., *73 Easting Re-Creation Data Book* (Westlake, Calif.: Illusion Engineering, Inc., 1992), IEI Report No. DA-MDA972-1-92, appendices, shoot history by vehicle for Eagle, Ghost, Iron Troops; "The Battle of 73 Easting," briefing slides prepared by Janus Gaming Division, TRADOC Analysis Command, White Sands, N.M., March 30, 1992 (henceforth TRAC brief), esp. slide 3 text, slide 16 text.

20. Scales, *Certain Victory*, pp. 292–300; Gordon and Trainor, *The Generals' War*, pp. 407–408; Rick Atkinson, *Crusade: The Untold Story of the Persian Gulf War* (Boston: Houghton Mifflin, 1993), pp. 465–467; U.S. News, *Triumph Without Victory*, pp. 377–386.

21. Scales, *Certain Victory*, pp. 282–284; U.S. News, *Triumph Without Victory*, pp. 357–370.

22. Scales, *Certain Victory*, pp. 267–270.

23. Kindsvatter, "VII Corps in the Gulf War," p. 17.

ment and morale in a six-week air campaign without exposing itself to extensive close combat on the ground.[24] Some members of this school, however, emphasize the Coalition's advanced ground-force technology, such as the thermal sights, compound armor, and depleted uranium (DU) ammunition of the U.S. M1A1 tank, arguing that these enabled Coalition ground forces to strike with virtual immunity from well beyond the effective range of the out-gunned, out-armored Iraqi defenders.[25] Others hold that the Coalition's maneuver warfare concepts (aided significantly by new navigation and communications technologies) enabled it to outflank a static Iraqi defense via sweeping maneuvers conducted over trackless desert, thus ejecting the Iraqis from Kuwait without requiring a costly frontal assault.[26]

On the other hand, some critics have argued that Iraqi shortcomings, not Coalition strengths, were the main reason for the war's one-sidedness. In particular, some have argued that Coalition losses were so low because an unmotivated, dispirited Iraqi army simply did not fight back. As John Mueller recently put it, "The Americans gave a war and no one showed up." A related argument holds that the Iraqis were militarily incompetent, or hopelessly outnumbered.[27] If so, then the Gulf War was less a revolution than merely the "mother of all military anomalies."[28]

In fact, both schools are wrong. To show why, it will be useful to decompose these arguments into their main component pieces. I begin by assessing each component individually, after which I address simple combinations thereof.[29]

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24. See, e.g., Gordon and Trainor, *The Generals' War*, p. 474; Perry, "Desert Storm and Deterrence," pp. 66–82; Inman, Nye, Perry, and Smith, "U.S. Strategy After the Storm," p. 284; HASC, *Defense for a New Era*, p. 7; Richard Hallion, *Storm Over Iraq: Airpower and the Gulf War* (Washington, D.C.: Smithsonian Press, 1992), pp. 241–268; Dilip Hiro, *Desert Shield to Desert Storm: The Second Gulf War* (New York: Routledge, 1992), pp. 320, 441.

25. See, e.g., Atkinson, *Crusade*, pp. 443–448, 467; U.S. News, *Triumph Without Victory*, p. 409; Scales, *Certain Victory*, pp. 364–367.

26. See, e.g., Freedman and Karsh, *The Gulf Conflict*, p. 437; Friedman, *Desert Victory*, pp. 235, 246, 252–253; James Blackwell, *Thunder in the Desert: The Strategy and Tactics of the Persian Gulf War* (New York: Bantam, 1991), pp. 220–223; Harry G. Summers, Jr., *On Strategy II: A Critical Analysis of the Gulf War* (New York: Dell, 1992), pp. 155, 265.

27. Mueller, "The Perfect Enemy," p. 106. See also Mazarr, Snider, and Blackwell, *Desert Storm*, pp. 113–117, 177–178; Jeffrey Record, *Hollow Victory* (Washington, D.C.: Brassey's, 1993), pp. 6, 135; James Pardew, "The Iraqi Army's Defeat in Kuwait," *Parameters*, Vol. 21, No. 4 (Winter 1991–92), pp. 17–23; Molly Moore, *A Woman At War: Storming Kuwait with the U.S. Marines* (New York: Charles Scribner's Sons, 1993), e.g. pp. 224, 275–276, 292, 302. For explanations involving Iraqi numerical inferiority, see Easterbrook, "Operation Desert Shill," pp. 32ff; HASC, *Defense for a New Era*, p. 34; Mueller, "The Perfect Enemy," e.g., pp. 79–96.

28. Record, *Hollow Victory*, p. 85.

29. With few exceptions (e.g., Mueller, "The Perfect Enemy"), the Gulf War literature is largely journalistic in nature and intent. As a result, causal relationships are frequently only implicit. I

COALITION STRENGTHS

The components of the "Coalition strengths" school are Coalition air technology, ground technology, and strategy.

AIR TECHNOLOGY. For new air technology to have caused an unprecedentedly low Coalition loss rate by destroying the Iraqis' equipment or morale before the ground war is to imply that the number of surviving, willing Iraqi weapons must also have been unprecedentedly low by February 24.[30] This was not so. The Iraqi armor force that survived the air campaign was still very large by historical standards, and many of these survivors fought back when attacked by Coalition ground forces.

It is now known that about 2000 Iraqi tanks and 2100 other armored vehicles survived the air campaign and were potentially available to resist the Coalition ground attack on February 24. Equipment attrition during the air campaign was highly variable. While some units suffered nearly 100 percent tank losses, others were virtually untouched. Overall, Iraqi tank attrition averaged about 48 percent, armored troop carrier losses were about 30 percent, and artillery losses were just under 60 percent. These were not uniformly distributed, however. In particular, the Republican Guard was significantly less hard-hit than the infantry and Army heavy divisions nearer the border—Guard tank losses, for example, came to less than 24 percent of their prewar KTO strength.[31]

Some of the surviving vehicles' crews surrendered without fighting, or after only token resistance, but others fought back. While the conscript infantry at the border lacked the will to fight (and may never have had it), the Republican Guard and at least some Army heavy divisions tried to resist the Coalition ground attack.

At 73 Easting, for example, 2nd ACR crews reported large volumes of small arms fire rattling off their vehicles during the assault, which means that Iraqi troops stayed at their weapons, returning fire, even as U.S. tanks passed within

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thus do not attempt to falsify individual accounts, but rather address reasonable articulations of the main lines of debate, and determine by process tracing which of these (if any) offer significant explanatory power.

30. In principle, even historically large Iraqi armor residual could still produce unprecedently low Coalition losses if the *ratio* of Iraqi survivors to Coalition attackers were unprecedently low, or if the Iraqi loss *rate* were so high as to render their survivors ineffective (though numerous). Neither exception holds here. For the former, see the discussion under "Iraqi Numerical Inferiority" below. For the latter, the causal mechanism is typically held to be the loss of will to fight: Leonard Wainstein, *The Relationship of Battle Damage to Unit Combat Performance*, IDA P-1903, (Alexandria, Va.: Institute for Defense Analyses, 1986), pp. 1–2. As argued below, however, this cannot explain the result here.

31. *GW Air Power Survey*, Vol. II, Part II, pp. 170, 214, 218–219.

a few hundred meters of their positions (i.e., within small-arms range).[32] In fact, some Republican Guard infantry are known to have remained at their posts, concealed, until U.S. attackers had actually driven through their positions, only then emerging to fire short range antitank rockets at the vehicles from behind.[33] Heavy weapons fire was also received. Although large-caliber hits were rare, multiple Iraqi tank gun rounds were observed falling near U.S. vehicles.[34]

Perhaps most important, the Tawakalna division not only defended itself when attacked, but also counterattacked the 2nd ACR after being driven from its positions. After nightfall the Iraqis struck the northernmost of the three U.S. cavalry troops engaged, attacking in multiple, reinforced company–strength waves, and supported by dismounted infantry.[35] This assault was broken up long before it posed a serious threat. Moreover, even in the Tawakalna there is little evidence to suggest fanatical combat motivation: more than 200 prisoners surrendered themselves after the battle.[36]

Nevertheless, there is no evidence to suggest that the Iraqis gave up without fighting in 73 Easting. On the contrary, the readiness of Republican Guard counterattackers to advance at all under such withering fire is difficult to square with a conclusion that the Guard had lost the will to fight. The Tawakalna had ample opportunity to surrender or escape if it wished. Iraqi conscripts at the border had given up in the midst of U.S. assaults without suffering harm; if the Tawakalna had wanted, it too could surely have surren-

32. See, e.g., Krause, *73 Easting Historical Introduction*, pp. 11, 12, 13, 15, 16, 19, 21, 22; Lieutenant Colonel Douglas A. Macgregor, "Closing with the Enemy," *Military Review*, February 1993, pp. 64–71, at p. 65.

33. Krause, *73 Easting Historical Introduction*, p. 12; Second Lieutenant Richard M. Bohannon, "Dragon's Roar: 1–37 Armor in the Battle of 73 Easting," *Armor*, Vol. CI, No. 3 (May-June 1992), pp. 11–17 at p. 16.

34. 73 Easting Data Base. See also Krause, *73 Easting Historical Introduction*, pp. 12, 16, 17, 22.

35. In fact, some participants reported numerous small scale counterattacks at various points in the battle: see, e.g., Krause, *73 Easting Historical Introduction*, pp. 12, 16, 20, 22; also Lieutenant John Hillen, "2d Armored Cavalry: The Campaign to Liberate Kuwait," *Armor*, Vol. C, No. 4 (July–August 1991), pp. 8–12 at p. 11. Not all of these, however, can be unambiguously identified as deliberate attacks—confusion over the location of U.S. and Iraqi forces, for example, may account for some movements of small, isolated Iraqi units toward U.S. forces. The analysis above is conservative in crediting as a true counterattack only the action repelled by Ghost troop after nightfall, which can be clearly distinguished as a deliberate counterattack by the behavior of the Iraqi units conducting the action (e.g., dismounting infantry, returning fire, and continuing to close with U.S. forces when taken under fire—such behavior is inconsistent with any interpretation other than deliberate counterattack): interview, Lieutenant Colonel Robert C. Turrell, USA (ret'd.), IDA, April 11, 1995. U.S. participants in the action were quite emphatic on this point. Krause, *73 Easting Historical Introduction*, p. 15.

36. Krause, *73 Easting Historical Introduction*, p. 14.

dered without fighting. Alternatively, when the 2nd ACR halted to consolidate, at least one other Iraqi battalion located within earshot of the battle had not yet been engaged; the halt offered this battalion an ideal opportunity to escape or surrender. Yet they stayed, fought, and were destroyed when the advance resumed after midnight. In fact, few prisoners on any part of the field were taken while their equipment was still operable; the great majority of those who surrendered did so only after the battle was over, when the Iraqis' armor had been destroyed and some 600 casualties had been suffered.[37]

Nor had the vehicles' crews deserted prior to the battle. The Tawakalna had moved on February 24 from its pre-invasion locations to occupy the blocking position from which it fought on February 26.[38] Vehicles lacking crews would not have been able to move and thus would not have been present on the 73 Easting battlefield. In fact, the entire Iraqi blocking force that opposed the VII Corps advance had redeployed into its battle positions only a few days before its destruction.[39] Though the Iraqi forces in the KTO as a whole were undoubtedly well under-strength by the time of the ground attack, the Guard and Army mechanized units that fought the VII Corps on February 26–28 had ample crews to man the equipment the VII Corps destroyed.

While we know more of the details for 73 Easting than for many of the war's battles, what we do know suggests that Iraqi behavior there was broadly representative of Guard and Army heavy divisions elsewhere as well. Reports of small arms fire striking Allied armor, for example, are widely distributed among accounts of the fighting on the 26th, 27th, and 28th, as are reports of Iraqi counterattacks, significant tank gun fire, and artillery action.[40] All suggest that the will to fight at 73 Easting was generally representative of the Iraqi blocking force, and possibly of other Iraqi units as well.

We will never know exactly how many of the Iraqis' surviving tanks fought back. We do know, however, that the great majority of Iraq's armor was concentrated in the higher quality units where Iraqi will to fight was greatest;

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37. TRAC brief, slide 3 text, slide 16 text. In Eagle Troop's sector, for example, no Iraqis were taken prisoner until after the battle, when a U.S. psychological warfare team was brought forward to broadcast surrender appeals in Arabic. Personal communication, Major H.R. McMaster, USA, September 8, 1995.

38. Scales, *Certain Victory*, pp. 232–236; Swain, *Lucky War*, pp. 244, 247; Gordon and Trainor, *The Generals' War*, pp. 387–388.

39. Scales, *Certain Victory*, pp. 232–236.

40. See, e.g., Nigel Pearce, *The Shield and the Sabre: The Desert Rats in the Gulf, 1990–91* (London: Her Majesty's Stationery Office, 1992), pp. 101, 102, 166; Swain, *Lucky War*, pp. 247, 254; Gordon and Trainor, *The Generals' War*, e.g., pp. 359, 363–368; Atkinson, *Crusade*, pp. 441–481; U.S. News, *Triumph Without Victory*, e.g., pp. 332–398; Freedman and Karsh, *The Gulf Conflict*, p. 397.

the conscript infantry that gave up most readily was systematically underequipped in heavy weapons and especially in armored vehicles.[41]

As a conservative lower bound on the number of actively resisting Iraqi tanks, one might count only those weapons in the remnants of five divisions from the Iraqi blocking force that are known to have resisted the VII Corps advance. These alone likely disposed of at least 600 surviving tanks and an additional 600 other armored vehicles on February 24.[42] A plausible range of active survivors might thus be 600 to 2000 Iraqi tanks, and 600 to 2100 other armored vehicles.

By contrast with these 1200 to 4100 Iraqi armored vehicles, the entire German army in Normandy had fewer than 500 tanks in July 1944. The Iraqi lower bound still had more tanks than the entire Israeli army in 1967. The upper bound had about as many as the entire Egyptian army in 1973.[43] If the Iraqis had inflicted only as many casualties per capita as the Arabs in 1967, the result would still have been radically higher Coalition losses.[44] Their inability to do so is thus hard to explain by pre-invasion losses of matériel or will power as a result of the air campaign.[45]

GROUND TECHNOLOGY. Could the Coalition's combination of thermal sights, new armor, stabilized 120 mm guns, and depleted uranium ammunition explain unprecedentedly low Coalition losses? If so, this would imply that

41. *GW Air Power Survey*, Vol. II, Part II, p. 169.

42. The estimate is derived from standard vehicle counts for Republican Guard and Army heavy division organizations as found in Friedman, *Desert Victory*, p. 294; Major John Antal, "Iraq's Armored Fist," *Infantry*, Vol. 81, No. 1 (January–February 1991), pp. 27–30; and Richard Jupa and James Dingeman, "The Republican Guards," *Army*, Vol. 41, No. 3 (March 1991), pp. 54–62; average air attrition for Guard divisions as of February 23 as given by *GW Air Power Survey*, Summary Report, p. 106; specific air attrition for the 12th and 52nd Armored Divisions as derived from interviews with captured Iraqi officers and reported in *GW Air Power Survey*, Vol. II, Part II, p. 214; and Iraqi divisional dispositions as reported, e.g., in Gordon and Trainor, *The Generals' War*, p. 388. Note that although personnel and weapon strengths were signficantly below nominally authorized levels in Iraqi infantry divisions, tank strength in Guard and Army Heavy divisions closely approximated nominal authorization; *GW Air Power Supply*, Vol. II, Part II, p. 388.

43. See, e.g., Martin Blumenson, *Breakout and Pursuit* (Washington, D.C.: Office of the Chief of Military History, 1961), p. 30; Cordesman and Wagner, *The Lessons of Modern War*, Vol. 1, pp. 15, 18.

44. In the 1967 Arab-Israeli War, an Arab defending army with 2,250 tanks killed about 300 Israeli tanks; while in mid-July 1944, a German force with only 230 tanks killed 500 British and Canadian tanks in defeating Operation Goodwood. Similar results for the February 24 Iraqi armored force would imply Coalition armor losses of perhaps 160 to 8000 vehicles, rather than the actual total of only 15 tanks and perhaps 25 other armored vehicles. For 1967 data, see Cordesman and Wagner, *The Lessons of Modern War*, Vol. I, pp. 15–18; for coalition tank losses, see DoD, *Conduct*, p. xiv; for ratio of, e.g., M1 to Bradley losses, see Kindsvatter, *VII Corps in the Gulf War*, p. 17; for more on Operation Goodwood, see Blumenson, *Breakout and Pursuit*, p. 193.

45. "Ironically, the loss of equipment, a key index of bomb damage assessment used during the war, was not decisive in any direct way. The Iraqi army did not run out of tanks, armored personnel carriers, or artillery." *GW Air Power Survey, Summary Report*, p. 117.

friendly forces in close combat *without* these technologies ought to have fared significantly worse than those equipped with them.

This was not so. Coalition ground force technology varied widely, but losses did not. The two U.S. Marine divisions, for example, were equipped mainly with 1960s-era M60A1 tanks with neither the thermal sights, 120 mm guns, DU ammunition, nor composite armor of the Army's M1A1s, yet the Marines suffered *fewer* tank losses than the Army against opposition that included Iraqi heavy divisions which fought back when attacked.[46] In fact, some of the Marines' heaviest fighting was by wheeled, thin-skinned, light armored vehicles (LAVs) such as those which defended against the Iraqi counterattack at the Burqan oil field.[47] The Army itself deployed thousands of lightly armored M2 and M3 Bradleys, and the British committed hundreds of similarly light Warrior troop carriers, all of which engaged in extensive close combat yet suffered very few losses.[48]

Second, a ground technology explanation implies that other battles between similarly equipped opponents should produce roughly similar results. Yet at the Army's National Training Center in the Mohave Desert, literally hundreds of battles have been fought between M1A1-equipped U.S. Army units and (simulated) T72-equipped OPFOR (or "opposition force") opponents, and the T72-equipped OPFOR almost always wins.[49]

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46. Marine tank losses were lower in both absolute terms and as a fraction of total strength. *Operation Desert Shield/Desert Storm, Hearings Before the Committee on Armed Services, United States Senate* (Washington, D.C.: U.S. GPO, 1991), S. Hrg. 102–326, hereafter cited as *Operation Desert Shield/Desert Storm*, pp. 79–80; U.S. Marine Corps Battlefield Assessment Team, *Armor/Antiarmor Operations in Southwest Asia*, Research Paper No. 92-0002 (Quantico, Va.: Marine Corps Research Center, July 1991), hereafter cited as USMC, *Armor/Antiarmor*, pp. v, 15. Note also that an Army brigade equipped with M1A1s (the "Tiger" brigade) was attached to support the Marine offensive, but most of the combat activity was borne by the Marine's organic M60A1s; ibid., p. A-2.

47. *Operation Desert Shield/Desert Storm*, pp. 66–68; Moore, *A Woman At War*, pp. 239–241, 245–248; Gordon and Trainor, *The Generals' War*, pp. 363–368.

48. The key ground force technology has, alternatively, been described as superior night-fighting equipment, which would pertain to Army M2s and M3s as well as M1s; see, e.g., Scales, *Certain Victory*, pp. 366–367. Marine LAVs and most Marine M60s, however, lacked thermal sights; the Army had loaned the Marines a small number of M60A3s with better night-vision equipment, but the great majority of Marine armor lacked this. Moore, *A Woman At War*, p. 200; DoD, *Conduct*, p. 747; Gordon and Trainor, *The Generals' War*, p. 359. Its absence did not cause heavier losses to the Marines. Moreover, not all the key ground battles were fought at night or in limited visibility conditions, yet daylight did not make the outcomes any less one-sided. See, e.g., Gordon and Trainor, *The Generals' War*, pp. 435–442. The U.S. Marines also used dismounted infantry, which lacked even the LAV's armor protection or weapon sights, in the initial assault of the ground campaign; *Operation Desert Shield/Desert Storm*, pp. 66–68.

49. See Lieutenant (P) John A. Nagl, "A Tale of Two Battles: Victorious in Iraq, An Experienced Armor Task Force Gets Waxed at the NTC," *Armor*, Vol. CI, No. 3 (May–June 1992), pp. 6–10. See also Daniel P. Bolger, *Dragons at War: 2–34 Infantry in the Mohave* (Novato, Calif.: Presidio Press, 1986).

COALITION STRATEGY. Others have argued that the Coalition's left hook strategy created the low loss rate by outflanking the Iraqis, forcing them to fight a war of maneuver for which they were ill-prepared.[50] But in fact, the key battles against the Republican Guard took the form of a corps-level frontal assault on a prepared positional defense from precisely the direction the Iraqis had anticipated when they established their blocking positions.[51] Moreover, the entire Marine offensive was a direct, frontal penetration of the Saddam line and the primary battle positions of the Iraqi heavy divisions to its rear.[52] Yet neither the VII Corps nor the Marines suffered heavily as a result.

IRAQI WEAKNESSES

The components of the "Iraqi weaknesses" school are Iraqi numerical inferiority and poor Iraqi troop skills and morale.

IRAQI NUMERICAL INFERIORITY. Many have argued that Iraqi forces in the KTO were seriously understrength, and thus heavily outnumbered by their Coalition opponents.[53] While the Iraqis' actual manpower will probably never be known, it was surely much lower than initial estimates suggested.[54] As a result, the Coalition clearly outnumbered them in the theater overall. In principle, this might explain radically low losses in either of two ways. First, a large force-to-force ratio (or preponderance of attackers over defenders) might enable the attacker to overwhelm the defense so quickly as to quash or preempt effective return fire. Second, a low defensive force-to-space ratio (few defenders

50. See, e.g., Freedman and Karsh, *The Gulf Conflict*, p. 437; Friedman, *Desert Victory*, pp. 235, 246, 252–253; Blackwell, *Thunder in the Desert*, pp. 220–223; Summers, *On Strategy II*, pp. 155, 265.

51. See, e.g., Swain, *Lucky War*, pp. 244, 246. Many of the individual engagements that made up these actions were likewise simple frontal assaults. The Iraqi defenses at 73 Easting, for example, were oriented to meet an attack from the west; 2nd ACR's axis of advance was a straight line almost due west to due east. See Krause, *73 Easting Historical Introduction*, pp. 1–15; Orlansky and Thorpe, *73 Easting*, pp. I-121 to 136; 73 Easting data base. The Battles of Norfolk, Medina Ridge, and Wadi al Batin were also direct frontal assaults: see, e.g., Scales, *Certain Victory*, pp. 267–270, 282–284, 292–300; Gordon and Trainor, *The Generals' War*, pp. 407–408; Atkinson, *Crusade*, pp. 465–467; U.S. News, *Triumph Without Victory*, pp. 377–386. Even at the border, VII Corps did not completely avoid the need to confront prepared defenders head-on: the 1st Infantry division conducted a deliberate breach of the Iraqi barrier system on the extreme right of the "Saddam line." Scales, *Certain Victory*, pp. 224–232.

52. See, e.g., Gordon and Trainor, *The Generals' War*, pp. 341, 358.

53. See, e.g., Mueller, "The Perfect Enemy," e.g. pp. 79–96; Easterbrook, "Operation Desert Shill," pp. 32ff; HASC, *Defense for a New Era*, p. 34; Eliot A. Cohen, "Tales of the Desert: Searching for Context for the Persian Gulf War," *Foreign Affairs*, Vol. 73, No. 3 (May/June 1994), pp. 141–142, 143; Gordon and Trainor, *The Generals' War*, p. 469.

54. *GW Air Power Survey* estimates 200,000–220,000 Iraqi troops on the eve of the ground invasion; Vol. II, Part II, p. 220. Other estimates have ranged from a high of 547,000 (the wartime U.S. Central Command [CENTCOM] figure) to a low of 183,000; HASC, *Defense for a New Era*, pp. 29–34.

spread over a large area) might preclude the conduct of a "coherent" defense, denying the defender the benefits of positional warfare.

But while the *theater* force-to-force and force-to-space ratios may have been very disadvantageous for the Iraqis, the *local* imbalances in many of the key battles were much less so. In many important engagements the Iraqis enjoyed favorable local force ratios, yet still failed to inflict heavier losses. If either of these two mechanisms had been a powerful cause, it should have showed up here in heavier Coalition losses, but this was not so.[55]

At Medina Ridge, for example, a Republican Guard brigade conducted a prepared positional defense on a frontage of under 10 kilometers against an attack of roughly equal size.[56] Standard Western defensive frontages for brigade-size units are about 10–20 kilometers (or up to twice the Medina's), and parity is normally considered a very disadvantageous force-to-force ratio for an attack.[57] Yet the Medina brigade was annihilated by frontal assault without inflicting a single Coalition fatality. At 73 Easting, the Tawakalna's 18th brigade conducted a prepared positional defense on a 15-km front and was attacked frontally by a smaller force, yet the defenders destroyed only one of the attackers' 68 armored vehicles before losing essentially all of their own. If high local force-to-space and low local force-to-force ratios could still produce such low Coalition losses, then it is far from clear that numerical imbalance provides an adequate explanation.[58]

IRAQI TROOP SKILLS AND MORALE. The other element of the "Iraqi shortcomings" argument is that Iraqi soldiers' skills and morale were very weak, while the Coalition's were very strong.[59] Iraqi morale was clearly much weaker, and they made many important errors in handling their forces. The Coalition's

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55. While local and theater ratios are usually different, the local conditions at the point of attack are the most important for casualty rates; the value of favorable theater ratios is the ability to create better local ones. See Biddle, *Determinants of Offensiveness and Defensiveness*, pp. 61–67. An explanation resting on the Coalition's favorable theater balance thus implies that this provided favorable local ratios at the key points, which were needed for the observed outcome. If the Coalition did just as well where local ratios were unfavorable, this poses serious problems for such an explanation.

56. Gordon and Trainor, *The Generals' War*, p. 407; U.S. News, *Triumph Without Victory*, p. 380.

57. For the upper bound frontage, see General John R. Galvin, "Some Thoughts on Conventional Arms Control," *Survival*, April 1989, pp. 99–107, at 103, and assuming, for the upper bound, three brigades abreast at Galvin's maximum divisional frontage. For the lower bound, see, e.g., Mearsheimer, "Numbers, Strategy and the European Balance," pp. 174–185, and assuming two brigades forward.

58. For other examples, see Nigel Pearce, *The Shield and the Sabre*, pp. 102, 110.

59. See, e.g., Mueller, "The Perfect Enemy," e.g., pp. 106–107; Mazarr, Snider, and Blackwell, *Desert Storm: The Gulf War and What We Learned*, pp. 113–117, 177–178; Record, *Hollow Victory*, pp. 6, 135; Pardew, "The Iraqi Army's Defeat in Kuwait," pp. 17–23; Moore, *A Woman At War*, e.g. pp. 224, 275–276, 292, 302.

people were clearly superior soldiers. In fact, Iraqi mistakes are a necessary element of my explanation, as I argue in more detail below. But they are only a part of the story, and cannot explain the result by themselves.

To explain a historically unprecedented outcome this way is to imply that no prior war could have seen a skill imbalance as great. The Coalition's Gulf War loss rate was lower by at least a factor of ten than the Israelis' in the Six-Day War, or the British against the Italians in North Africa in 1941, or the Royal Marines against Argentine Army conscripts in 1982.[60] Of course, it is hard to measure skill differentials precisely.[61] But it is far from obvious that the difference between Coalition and Iraqi skills in 1991 dwarfs the imbalance between any of these armies. In each case the attacker enjoyed a major advantage in personnel quality and motivation, yet in no case were the attacker's losses anywhere near as low as during the Gulf War. Given this, it seems more likely that skill and motivation comprise only a part of a much larger picture. The challenge for analysis is to understand the complete picture, and how its pieces fit together.

SIMPLE COMBINATIONS OF CAUSES

How might such a larger picture fit together? One possibility is a simple linear combination of the causes described above. While there are too many possible combinations to address each individually, two general points should be made.

First, while much of the literature cites multiple causes, the analysis of causal mechanisms (or *how* the cited factors brought about the observed outcome) is almost always strictly univariate. That is, individual causes (and their effects) are described independently, providing no reason to expect the combination of several causes to yield more than just the sum of the parts taken individually.

Second, to explain the Gulf War, the sum of the parts must be large indeed. The Coalition loss rate was far lower than even very one-sided historical battles. To explain an order-of-magnitude difference in loss rates between 1991 and 1967 or 1982, for example, by a linear combination of contributing causes thus requires either a long list of contributors, or that at least some be very powerful.

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60. Cordesman and Wagner, *The Lessons of Modern War*, Vol. I, pp. 15, 18; ibid., Vol. III, pp. 255–256, 261, 267; George Bruce, ed., *Harbottle's Dictionary of Battles*, p. 232.

61. In fact, no systematic attempt has yet been made to show that the 1991 skill differential was unusually large in historical terms. On the contrary: Mueller, for example, actually implies that the incompetence he ascribes to the Iraqis is typical of other defeated armies in previous Mideast wars ("The Perfect Enemy," p. 79n). While this seems quite plausible, it poses important difficulties for the "Iraqi incompetence" argument as an explanation of a historically unprecedented outcome.

The available information, however, provides little evidence to support such a conclusion. Each of the existing univariate explanations poses serious inconsistencies with the historical record. To explain, for example, the difference in attacker loss rate between the 1991 and 1967 Mideast wars by reference to the linear combination of 1991 air-induced attrition (or non-resistance); 1991 ground technology; skill or combat motivation; and Coalition numerical superiority is to imply that the latter three effects account for more than a factor of four in Iraqi combat performance relative to the Arabs' in 1967,[62] even though Coalition ground technology varied widely across the theater of war; the Arab-Israeli skill/motivation imbalance in 1967 was arguably as large as that of 1991 or nearly so; and many of the key engagements in 1991 were fought without meaningful local numerical advantages.

While such a possibility cannot be entirely ruled out, it is at least not obvious that the effects cited offer the necessary explanatory power in light of all that is now known. The case for an adequate explanation by simple linear combinations of causes is thus far from made.

But while an adequate *linear* combination may be hard to assemble given the limited strength of the component univariate pieces, nonlinear synergistic effects might enable a stronger explanation to be drawn from the same components, since nonlinear explanations permit the multivariate whole to be greater than the sum of its parts. An adequate nonlinear multivariate explanation, however, requires a new causal mechanism, and a demonstration that this mechanism is consistent with the observed events of the war.

Synergistic Interaction of Skill and Technology

A synergistic interaction between technology and skill enables a more robust accounting on the basis of a smaller number of underlying causes. In particular, the evidence suggests that in the Gulf War, advanced technology raised the

62. In 1967, an Arab force with 2250 tanks killed about 300 Israeli tanks; in 1991, the active residual of Iraqi armor that remained after accounting for air-induced attrition numbered at least 600 tanks and 600 other armored vehicles, but killed only 15 Coalition tanks and perhaps 25 other Coalition armored vehicles. Of course, this is a crude comparison; weapons other than armored vehicles can kill tanks, for example. But to include non–armored-vehicle based antitank weapons would be to increase the difference to be explained by the latter three effects above, since such weapons' effectiveness has generally increased since 1967 (making the Iraqis' inability to kill more than 40 Coalition armored vehicles still more surprising). Likewise, to leave out tanks killed by Israeli aircraft in 1967 is conservative, as this overestimates the number of Arab tanks that survived to engage Israeli tanks, thereby reducing 1967 per capita Arab performance, and thus understating the difference between 1967 and 1991. For 1967 results, see Cordesman and Wagner, *The Lessons of Modern War*, Vol. 1, pp. 15, 18.

costs of defensive error dramatically relative to the consequences of similar mistakes in the past, making possible a radical reduction in attacker losses against an error-prone opponent.

To show how and why, I first describe in some detail a representative sampling of Iraqi mistakes. I then lay out a theory of how such mistakes might have combined with new technologies to create an unprecedented outcome. I close the section with a counterfactual analysis testing this theory against the 73 Easting data base.

IRAQI FORCE EMPLOYMENT MISTAKES

The Iraqi military displayed very poor combat skills by contemporary Western standards. This can be illustrated by focusing on just three of their many tactical shortcomings.[63]

First, Iraqi defensive positions were very poorly prepared. The "Saddam line" at the Saudi border was haphazard at best (although given the poor quality of its conscript garrison, it is unclear how significant this was). More important for the outcome, the Republican Guard blocking positions were no better. Western armies dig their fighting positions into the earth below grade, and hide the soil removed in excavation. The Guard, on the other hand, simply piled sand into loose berms, or mounds, on the surface of the ground around combat vehicles and infantry positions.[64] This gave away the defenders' locations from literally thousands of meters away, as the berms were the only distinctive feature of an otherwise flat landscape, without providing any real protection against the fire this inevitably drew.[65] Loose piles of sand cannot stop modern high-velocity tank rounds. In fact, they barely slow them down. U.S. crews in 73 Easting reported seeing 120 mm tank rounds pass through

63. While the Iraqis made serious mistakes at all levels of war, their failings at the tactical level were both necessary and sufficient (together with new U.S. technology) to explain the resulting loss rate. Even given the Iraqis' strategic and operational errors, if their troops' tactical performance had been to Western standards then Coalition losses would probably have reached or exceeded prewar expectations, as the counterfactual analysis below suggests. But without better tactical performance, no improvements in strategy or operational art could have changed the Iraqis' fate much in a shooting war. Even outnumbered U.S. attackers annihilated dug-in, actively resisting Iraqi defenders by frontal assault in close combat; if the troops behind the triggers cannot kill targets under such conditions, it is hard to see what even virtuoso generalship could do to change the results.

64. Orlansky and Thorpe, *73 Easting*, p. I-54.

65. It was standard operating procedure in the 2nd ACR to fire at any berm, whether a target had been positively identified behind it or not. Robert Zirkle, "Memorandum for the Record: Information Obtained During West Point/IDA Janus 73 Easting Session, 8–10 April 1992," Institute for Defense Analyses, April 15, 1992, p. 2. On berms, see, e.g., TRAC brief, slide 10 text.

Iraqi berms, through the Iraqi armored vehicle behind the berm, and off into the distance.[66] No U.S. tank crew would leave itself so exposed.

Republican Guard positions were also virtually devoid of anti-tank mines, ditches, wire entanglements, or any other attempts to delay or channel an attacker's progress.[67] In Western armies, units automatically begin preparing their positions as soon as they occupy them. If kept in place for more than a few hours, they begin to dig fighting positions, construct barriers and lay mines, with engineering assistance if available, but if not, then with the unit's own manpower. The Iraqi blocking positions had evidently been occupied for some time, yet they remained without even rudimentary countermobility preparations.[68] No U.S. unit would remain so inactive.

Second, the Republican Guard failed to coordinate the efforts of the different arms at its disposal. In particular, artillery support was almost wholly absent, both in defense against American assaults and in support of the Guard's own counterattacks. The Iraqis made some attempt to direct artillery against the advancing Americans, but proved unable either to adjust fire against moving targets (a difficult task) or even to deliver fire in mass against fixed points as Americans moved past them (an easier job).[69] The Iraqi counterattack at 73 Easting was executed with only a rudimentary attempt to suppress U.S. fire with artillery, or to screen the advance with artillery-delivered smoke.[70] Nor

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66. See, e.g., Orlansky and Thorpe, *73 Easting*, p. I-54; Peter Tsouras and Elmo C. Wright, Jr., "The Ground War," in Bruce W. Watson, ed., *Military Lessons of the Gulf War* (Novato, Calif.: Presidio Press, 1991), pp. 81–120; *Operation Desert Shield/Desert Storm*, p. 115. Solid earth in sufficient depth can stop any current tank gun, but this requires the tank to be dug into the ground, not perched above it behind piles of sand.

67. At 73 Easting, for example, no systematic minefields were found, nor were there any apparent attempts to erect barriers of any kind to slow U.S. movement through the engagement area. Zirkle, "Memorandum for the Record," pp. 1, 2.

68. Iraqi engineers had begun to prepare blocking positions in this area some two weeks prior to the battle (i.e., before the ground war began) in anticipation of a possible Coalition advance from the west; Scales, *Certain Victory*, pp. 233. The maneuver units that occupied these positions apparently neither expended significant labor themselves to further prepare the ground subsequent to its occupation, nor conducted training or operational rehearsals *in situ* (as any U.S. unit would). Orlansky and Thorpe, *73 Easting*, pp. I-54, 59. Iraqi infantry at the frontier were provided with much more extensive counter-mobility engineering, although these obstacles were often poorly constructed. See, e.g., DoD, *Conduct*, pp. 251–253; Murray Hammick, "Iraqi Obstacles and Defensive Positions," *International Defense Review*, Vol. 24, No. 9 (September 1991), pp. 989–991.

69. See, e.g., Krause, *73 Easting Historical Introduction*, p. 28; Scales, *Certain Victory*, pp. 117–118, 293; Atkinson, *Crusade*, p. 212; Robert H. Scales, Jr., "Accuracy Defeated Range in Artillery Duel," *International Defense Review*, May 1991, pp. 473–481.

70. Krause, *73 Easting Historical Introduction*, pp. 17–18. The Iraqis proved unable to implement evasive "shoot and scoot" tactics (wherein artillery relocates immediately after firing so as to avoid counterfire), and U.S. counterfire quickly silenced the Iraqis' one attempt to provide fire support. Orlansky and Thorpe, *73 Easting*, p. I-145.

did the Iraqis make any attempt to scout the ACR's positions before the assault, to use engineers to create smoke or other obscuration, or to coordinate assault forces' movement with the use of overwatch elements to provide covering fire.[71]

Third, Iraqi covering forces systematically failed to alert their main defenses of the U.S. approach, allowing even Republican Guard units to be taken completely by surprise. Going back at least as far as World War I, all Western armies have used covering forces—whether observation posts, forward reconnaissance screens, or delaying positions—to provide warning to the main defenses that they are about to be attacked. Ideally, these covering forces serve other functions as well (such as stripping away the opponent's recon elements, slowing the attacker's movement, or channeling the assault), but the minimum function they must perform is to notify the main defense of an attacker's approach. This is not difficult. A one-word radio message is enough to sound the alarm. Even less can work if commanders agree in advance that failure to check in at specified times will be taken as warning of attack. The brevity of the message makes it virtually impossible to jam; the procedural backup of interpreting silence as warning means that even a dead observer can provide an alert.[72]

Yet at 73 Easting, for example, the Iraqi main position received no warning of the 2nd ACR's approach. A few observation posts were deployed well forward of the main defenses, but these were evidently destroyed without sending any messages, and without the local commander interpreting silence as evidence of attack.[73]

As a result, the Iraqi defenders were unready to meet the attack when it arrived. At a minimum, this slowed their reaction time in the initial exchange of fire. It may also have provided some U.S. attackers an opportunity to engage empty targets for the crucial opening minutes of the battle. Combat vehicles are rarely fully manned unless standing watch or otherwise on alert, which the Tawakalna as a formation was not. Thus it is likely that only a few on-watch vehicles were fully manned, while others would have been empty or manned by skeleton crews. In fact, there is evidence to suggest that many Iraqi crews

71. Krause, *73 Easting Historical Introduction*, pp. 17–18.
72. See, e.g., Kenneth Macksey, *First Clash* (New York: Berkeley Books, 1988), p. 102.
73. A captured Iraqi lieutenant later reported that his first indication that he was under attack was when "the turret of the tank next to him blew off." Steve Vogel, "A Swift Kick: 2d ACR's Taming of the Guard," *Army Times*, August 5, 1991, pp. 10ff at p. 30; see also Krause, *73 Easting Historical Introduction*, p. 32.

interpreted the opening explosions of the battle as an air attack (they had received no warning of a ground advance); hence even some skeleton crews abandoned their vehicles to take cover in nearby air raid shelters at the very moment the ground attack began. As the attack's nature became clear, many of these crews attempted to remount, but by then dozens of Iraqi tanks and BMPs had already been destroyed, and by the time the remounting crews could get their weapons into action still more had been lost.[74]

By contrast, U.S. troops fought extremely well. At 73 Easting, for example, the 2nd ACR maintained a tight, efficient combat formation throughout an extended approach march, and did so in the midst of a sandstorm, in hostile territory, over unfamiliar terrain, and without significant losses to mechanical breakdown or logistical failure en route. Its crews' gunnery was exceptional, outperforming peacetime proving ground standards for both the M1 and the Bradley. The first three kills by Eagle troop were recorded in three shots by a single M1 over an interval of less than ten seconds.[75] As a whole, 182 of 215, or 85 percent, of the shots fired by 2nd ACR crews struck their targets at ranges of up to 2000 meters, under combat conditions.[76] Similar results were obtained by U.S. forces throughout the KTO.[77]

THE PRICE OF MISTAKES AS A FUNCTION OF THE OPPONENT'S TECHNOLOGY

Mistakes are always damaging, and errors like poor position preparation, weak combined arms coordination, or failure to provide attack warning would hurt any twentieth-century defender. As technology has become more sophisticated, however, the consequences of such errors have progressively risen.

For example, against an attacker on foot armed with light machine guns of under 100 meters' effective range and supported only by artillery with little

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74. Krause, *73 Easting Historical Introduction*, pp. 21, 32; Orlansky and Thorpe, *73 Easting*, p. I-117; interview, Lieutenant Colonel Robert C. Turrell, USA (ret'd), IDA, April 11, 1995. In Ghost troop's sector, for example, some 18 minutes elapsed between the time U.S. attackers made initial contact with the Tawakalna main line of resistance and the first observed return fire by the Iraqis; Krause, *73 Easting Historical Introduction*, p. 16. Properly-manned defending vehicles would ordinarily return hostile fire immediately (indeed, defenders ordinarily get the first shot in tactical mechanized combat). Not all Tawakalna vehicles were empty, however; at least some 2nd ACR crews reported receiving Iraqi fire or observing tank turret movement from the beginning of the battle. Interview, Captain H.R. McMaster, USA, January 1994.

75. Krause, *73 Easting Historical Introduction*, pp. 11–12; personal communication, Major H.R. McMaster, USA, September 8, 1995. Another M1 in Eagle troop killed two T72s and two BMPs with four shots in one minute: see IEI Report No. DA-MDA972-1-92, appendix, shoot history by vehicle for Eagle Troop, p. 4.

76. Ibid., appendices, shoot histories by troop.

77. See, e.g., Scales, *Certain Victory*, pp. 361–364.

capability to adjust fire quickly, such defensive errors would be harmful but not necessarily catastrophic.[78] Against an armored attacker with an effective range of 500–1000 meters in daylight, and supported by aircraft dropping unguided bombs, the cost would be higher.[79] But against an attacker with all-weather, day/night thermal tank sights, stabilized 120 mm guns armed with DU ammunition effective on the first shot at 3000 meters, aircraft armed with precision-guided munitions (PGMs) and complete command of the sky, or attack helicopters with 5000 meter-range missiles capable of responding in minutes to a radio call from a forward observer, such slip-ups can very quickly be lethal to a very large number of defenders. If the defenders' mistakes are varied enough, and the attackers' suite of sophisticated technologies is diverse enough, then the number of ways in which defensive error can combine with decisive offensive exploitation becomes so wide as to enable a heterogeneous attack force, some of it sophisticated and some not, to find ways to prevail with very limited costs to any part of the offensive array.

While such interactions can dramatically increase weapon effectiveness, they can also imply very different roles, or mechanisms, by which specific systems influence outcomes. Perhaps the best example may be Coalition air technology. Most analyses have focused on its ability to destroy ground targets directly (and to influence Iraqi morale via direct attack of ground targets). Yet its *indirect* role in increasing Coalition *ground* force effectiveness—for example by increasing the cost of Iraqi covering force mistakes—may have been just as important and possibly broader in its impact.

Coalition air supremacy exposed Iraqi ground targets to continuous air attack. Many Iraqis survived these attacks, but responded by reducing vehicle manning levels: vehicles were known to be the primary air targets, and had virtually no capability against Coalition aircraft, hence many of the skeleton crews that might ordinarily have been left to stand watch were removed from Iraqi tanks and troop carriers. Moreover, weeks of unopposed air attack eventually bred a widespread assumption that all attacks were from the air, encouraging a reflex action of seeking cover in air raid shelters rather than in armored

78. Compare, for example, the mistakes by the British 3rd and 5th Armies in March 1918, which produced a German breakthrough and 40-mile exploitation, but did not destroy the Allied position in the theater (and still cost the Germans an estimated 250,000 casualties). Biddle, *The Determinants of Offensiveness and Defensiveness*, pp. 241–311.

79. See, e.g., the account of the Arab armies' defeat by the Israelis in 1967 in Chaim Herzog, *The Arab-Israeli Wars* (New York: Random House, 1982), pp. 143–192. Note, especially, the effects of Egyptian maldeployment, mistakes regarding terrain passability, and air force unreadiness; ibid., pp. 152, 157, 159, 161.

vehicles when under fire.[80] This greatly increased the effects of the Iraqis' failure to provide warning of ground force attack. It always hurts to be surprised. But when apparently invulnerable aircraft induce defenders to reduce vehicle manning levels, surprise takes on new significance: instead of partially manned weapons providing hasty covering fire while the remainder of their crews remount, empty vehicles now remain silent while their crews remain under cover trying to determine whether the attack is from the air (in which case they should stay put) or the ground (indicating they should remount).[81] The result was a powerful, but indirect, interaction effect of superior air technology and Iraqi error: by increasing the frequency with which targets would be unoccupied as a result of the Iraqis' failure to obtain warning, Coalition air technology increased friendly ground forces' ability to exploit Iraqi covering force mistakes.[82]

But while advanced technology has raised the cost of error dramatically, it has not affected well-handled defenses to nearly the same degree. While U.S.

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80. *GW Air Power Survey*, Summary Report, pp. 56, 117.

81. Considerable evidence suggests that this was widespread in the Gulf War. The Marine Corps, for example, has estimated that the majority of all Iraqi armored vehicles destroyed on the Marines' front were unoccupied when killed; USMC, *Armor/Antiarmor*, p. 18. Reports of Iraqi crews scrambling to remount their vehicles upon ground attack are common. In addition to 73 Easting, see, e.g., Steve Vogel, "Metal Rain: Old Ironsides and the Iraqis Who Wouldn't Back Down," *Army Times*, September 16, 1991, pp. 8ff at p. 16: "Iraqi prisoners [taken at Medina Ridge] later said they thought the artillery was an air attack, and many had abandoned their vehicles for bomb shelters. . . . [thereafter] in their thermals, the U.S. crews could see Iraqi soldiers leaving their bunkers and reboarding tanks and BMP infantry fighting vehicles. 'A lot of them were mowed down trying to get back to their vehicles,' said [Major Chess] Harris, the 3d Brigade's executive officer." See also DoD, *Conduct*, pp. 139–140; Atkinson, *Crusade*, p. 466; Steve Vogel, "Hell Night: For the 2d Armored Division, It Was No Clean War," *Army Times*, October 7, 1991, pp. 8ff at p. 15; Krause, *73 Easting Historical Introduction*, p. 19, describing 2nd ACR engagements prior to 73 Easting.

Of course, many Iraqis deserted (see, e.g., Gordon and Trainor, *The Generals' War*, p. 352); at least some kills of empty vehicles are doubtless attributable to desertion rather than the interaction of air attack and poor tactical warning. This cannot fully explain the results above, however—and in particular, desertion is likely to be a minor contributor to empty vehicle kills in the VII Corps action against the Iraqi blocking force, for three reasons. First, Iraqi attempts to remount vehicles were widely observed by U.S. troops. Second, Iraqi armor was concentrated in units whose will to fight was highest, and whose desertion rates were lowest (note, e.g., the absence of the Iraqi blocking force divisions from the list of high-desertion units given in ibid.). But third, and most important, much of the heaviest fighting involved Iraqi units that had moved into their battle positions within at most a day or two of the battles that destroyed them. Vehicles lacking crews could not have done this. Much of the war's armored ground combat thus involved Iraqi weapons whose crews were present at the battlefield.

82. Other indirect effects of Coalition air technology include reducing Iraqi command responsiveness by destroying command posts and communications systems, and complicating management of Iraqi ground maneuver through the constant threat of air attack, thus slowing major redeployments and encouraging them to fight from static positions. *GW Air Power Survey*, Summary Report, pp. 70–1, 99n, 116, 119; Orlansky and Thorpe, *73 Easting*, p. I-59. Each magnified the problems of poor Iraqi combat skills and created opportunities for Coalition ground forces even without killing Iraqi armor directly.

120 mm guns with DU ammunition can perforate mounded dirt and destroy ill-prepared tanks from thousands of meters away, they cannot penetrate enough solid earth to harm a tank dug into the ground properly rather than perched on the surface. Thermal sights can identify exposed targets from tremendous distances at night, through dust, or in a sandstorm, but they cannot see targets that have been properly concealed below ground level. Air supremacy can induce defending tank crews to reduce manning levels, but if the defender's covering forces provide proper warning, then vehicles will be reoccupied before they can be overrun. In general, skillful handling of defending forces can thus often foreclose an attacker's best technological opportunities and thereby erode markedly the advantages of even very superior opposing weapons.

Even advanced technology and defensive error, however, cannot provide victory at very low losses unless the *attacker* is highly skilled. Opportunity is meaningless unless it can be exploited, and finding ways to exploit diverse and often idiosyncratic or unexpected defensive mistakes requires flexibility, initiative, and insight. The advanced weapons that provide the opportunity must be operated to their full potential, and such weapons often demand higher levels of training than do simpler systems. And mistakes can kill attackers, too. Even simple, hand-held antitank rockets fired from poorly prepared defensive positions can kill the most advanced tank if allowed a clear shot from the right direction at the right distance. Skilled offensive force employment is required if such opportunities are to be denied to the defense.

Offensive skill, defensive error, and advanced technology thus interact in a powerful, nonlinear way. Given an advanced technology attack, defensive error yields rapid, one-sided defeat, whereas the same mistakes against older technology would produce much less dramatic effects. Moreover, the combination of advanced technology and defensive error requires offensive skill to produce radically low losses: unskilled attackers may not find the right matches between defensive error and offensive technology, nor implement them without allowing defenders too many openings to kill attackers in the process. Each causal variable's effects thus change dramatically as a function of the others' presence or absence; contributing causes that are weak alone can be very powerful in interaction. This in turn enables an extreme outcome to be explained without having to pile up a long list of modest contributors.

By contrast with univariate or multivariate linear alternatives, this explanation can account for much of the new evidence on the conduct of the war. It explains, for example, how Coalition troops could fight through substantial,

unbroken ground defenses without heavy losses; how a diverse array of Coalition weapons could prevail so one-sidedly against the Iraqis, when similar weapons cannot do so against the nearly error-free OPFOR at the National Training Center; how Coalition attackers could succeed even at modest local numerical advantages; and why historical skill mismatches (at lower levels of technological sophistication) have never provided such low offensive losses in the past. Finally, this explanation provides a causal mechanism by which a modest list of causes with modest power individually might combine to induce dramatic overall effects.

SIMULATION EXPERIMENTS

To explore the idea more fully, and from a different direction, I return to the 73 Easting Project, and in particular, to the computer simulations of the battle conducted by the Institute for Defense Analyses and the U.S. Army.[83] Many runs have been conducted in the course of the project; I concentrate here on a subset designed to examine the effects of technology and troop skills on casualty levels. In particular, these runs look at the interactions of:

- two of the Iraqi errors described above: poor defensive preparations, and failure of the covering forces to provide warning;
- two forms of the Coalition technological advantage described above: the thermal sights of the M1A1, and the air defense suppression systems that enabled Coalition aircraft to operate with impunity over the KTO; and
- one potential error in Coalition force employment that Coalition skill averted but that a less proficient force might have committed: a strung-out assault formation as a result of the 2nd ACR's extended approach march.

The runs are designed to contrast a base case corresponding to the historical technology, U.S. force employment, Iraqi unit dispositions, and the two Iraqi errors described above with a set of excursion cases (or scenarios with controlled variations from the base case), in which Iraqi errors are systematically

83. The 73 Easting Project has used two simulation systems, the IDA/DARPA Simnet, and the Army Janus model. Though Simnet has been the main vehicle for building and demonstrating the Project data base, both IDA and the Army have used Janus for complementary analyses. Janus offers quicker turn-around in exchange for simpler graphics and a somewhat more abstract user interface; it is thus less well suited for re-living the battle with its participants to establish the actual events, but better suited for running large numbers of counterfactual cases once the data base is complete. The analyses described here used Janus. For details, see W.M. Christenson and Robert Zirkle, *73 Easting Battle Replication*, IDA P-2770 (Alexandria, Va.: Institute for Defense Analyses, 1992).

corrected, Coalition technological advantage is systematically reduced, and Coalition skills are impaired.[84]

The results are summarized in Table 1, and illustrated graphically in Figure 1. They suggest four key observations.

TECHNOLOGY AGAINST AN ERROR-FREE DEFENSE. First, against an error-free defense, the 2nd ACR's technology overmatch did not provide victory at very low losses. Scenario A assumes that both of the Iraqi errors considered here are corrected—that is, that the above-ground revetments of the historical battle are entirely replaced with below-ground, turret-down positions from which the occupants move up to a hull-down posture upon acquiring a target;[85] and that functioning observation posts provide tactical warning of the attackers' approach. Coalition technology, Coalition skill, and all other aspects of the base case are held constant. As a consequence, simulated U.S. vehicle losses rise

84. This base case accurately represents the real battle's technology, dispositions, movements, and U.S. combat skills, but credits the Iraqis with much better skills than they actually displayed—even though it accounts for the two mistakes of poor position preparation and poor covering force performance. Janus assumes nominal (i.e., U.S.-quality) crew performance and unit behavior unless told otherwise; errors must be deliberately introduced to be considered. By introducing two such errors, the base case thus considers some, but far from all, of the Iraqis' actual mistakes (excluding, e.g., their poor tank gunnery, fire coordination, and vehicle maintenance). When the two introduced mistakes are removed, the result is thus very nearly an error-free Iraqi defense. The results are therefore treated as properties of error-free performance, but this does *not* imply that the Iraqis need only have fixed their position engineering or covering force discipline to reap the benefits described. For the Republican Guard (much less Iraqi conscript infantry) to approach the performance credited them in the "no errors" case would have required much more sweeping reforms. In all excursion scenarios, historical deployments and movement tracks were retained (though in scenario G, some U.S. arrivals are delayed to create a strung-out U.S. formation). Neither U.S. nor Iraqi movements were predicated on the presence (or absence) of thermal sights, air supremacy, or poor Iraqi covering force discipline or position preparation—thus there is no reason to assume that these movements would have differed for any of the given excursion scenarios. At least one of the 2nd ACR's company grade officers has stated explicitly that his plan of maneuver would have been the same with or without the changes embodied in the excursion scenarios above. Interview, Captain H.R. McMaster, USA, January 1994. Finally, note that the mean base case simulation results—two U.S. vehicle losses—closely approximate the historical outcome: one. See Christenson and Zirkle, *73 Easting Battle Replication.*

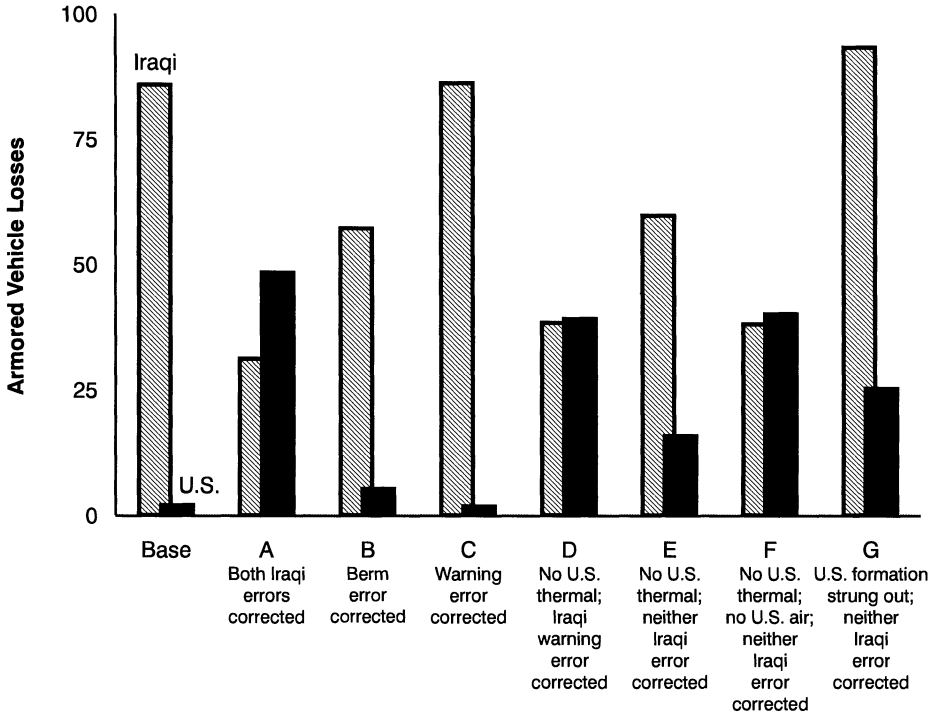
85. In a "turret-down" or "turret-defilade" position, the entire vehicle is below grade, and is thus masked from opposing observation or fire; only the commander's hatch is above grade. Thus, a turret-down tank cannot fire its main gun (or be fired upon by opposing tanks), but the vehicle commander is able to search for targets by standing in the open hatch and scanning his surroundings with binoculars. In a "hull-down" or "hull-defilade" position, the vehicle's hull is below grade, but the turret is exposed. A hull-down tank can thus fire and be fired upon, though the defilade reduces the vehicle's vulnerability by reducing its presented area. In Western practice, prepared fighting positions for tanks are ordinarily dug as a ramp, connecting a deeper, turret-down position and a shallower, hull-down location; above-ground revetments are avoided. Headquarters, Department of the Army, *FM 5–103, Survivability* (Washington, D.C.: U.S. GPO, June 1985), pp. 4-14–4-15; Richard Simpkin, *Tank Warfare* (New York: Crane Russak, 1979), pp. 97, 112, 160, 167; Macksey, *First Clash*, p. 55.

Table 1. Simulation Experiment Results.

Scenario	Key Features	U.S. Armored Vehicle Losses			Iraqi Armored Vehicle Losses			Loss Exchange Ratio (Iraqi:U.S. losses)
		Mean	Standard Error	Fractional Loss	Mean	Standard Error	Fractional Loss	
Base		2.00	0.94	0.03	85.80	3.46	0.77	42.90
A	Both Iraqi errors corrected	48.30	4.30	0.71	31.20	5.98	0.28	0.65
B	Iraqi berm error corrected	5.30	1.83	0.08	57.20	4.24	0.51	10.79
C	Iraqi warning error corrected	1.80	0.92	0.03	86.10	3.70	0.77	47.83
D	No U.S. thermal; Iraqi warning error corrected	39.10	2.18	0.58	38.30	3.23	0.34	0.98
E	No U.S. thermal; neither Iraqi error corrected	15.90	5.13	0.23	59.80	5.35	0.53	3.76
F	No U.S. thermal, no U.S. air; neither Iraqi error corrected	40.00	2.10	0.59	38.00	3.30	0.34	0.95
G	U.S. formation strung out; neither Iraqi error corrected	25.20	2.86	0.37	93.20	0.63	0.83	3.70

NOTES: Fractional loss provides the mean loss expressed as a fraction of the total vehicles available to that side at the beginning of the battle. For each scenario, ten runs were conducted; mean values provide arithmetic means for each set of ten runs.

Figure 1. Simulation Experiment Results (73 Easting).



from only two in the base case to almost 50 (more than 70 percent of total U.S. strength), while Iraqi losses fall from 86 to about 30, even given the technological advantages of the M1A1, the effects of Coalition air supremacy, and the skilled handling of the U.S. attack.[86]

How is it that defensive error (and its absence) has such a large effect on attacker casualties here? The answer has to do with the way Iraqi errors play into the strengths of U.S. technology. Many have argued, for example, that thermal sights gave the United States an enormous range advantage over the

86. The U.S. Army's simulation results differ with respect to variations in Iraqi defensive posture; this is because they assume only hull defilade, rather than a ramped, turret-to-hull defilade, position for the Iraqis: TRAC brief. In effect, the Army analysis thus assumes only partial improvement of Iraqi force employment—and as a consequence, the Army results much more closely resemble those obtained here for partial, but incomplete, improvement in defender skills.

Iraqis in the raging sandstorm of February 26.[87] For superior target acquisition range to be useful, however, there must be exposed targets to acquire. In the base case, the Iraqis' poorly constructed above-ground revetments guarantee this. In fact, the berms advertise the defenders' locations to attackers with advanced sights. In excursion scenario A, on the other hand, correct terrain preparation causes the Iraqis' vehicles to be concealed in turret-down positions unless their own crews see targets. At long range, where the thermal sight enables the attacker to see in spite of the sandstorm but where the defender's simple optics are blinded, the defenders (who see no targets) now remain concealed and the attackers have nothing to shoot at. Only when the attackers close the range and are seen do the defenders move into hull-down firing positions and become exposed. The net result is that the firefight takes place at much shorter range, and the long potential acquisition range of the thermal sight is negated.

Similarly, the Iraqis' failure to provide warning plays into the strengths of Coalition air technology. Advanced air defense suppression systems (together with the defeat of the Iraqi air force) afforded the Coalition air supremacy over the KTO. While this did not produce extensive direct air attrition to the Iraqi units that fought in 73 Easting, it did indirectly reduce their average manning levels. This potentially reduced their return fire in the critical opening minutes of the battle, and potentially enabled the attackers to kill undermanned Iraqi vehicles before they could be fully ready to fight. But to realize this potential required that the defenders be taken by surprise. If the main defenses had been warned in time, they could have regained full readiness before meeting the attack, thus negating the indirect effects of Coalition air supremacy. In the historical battle (and the simulated base case), the Iraqi covering force's failure to send an alert prevented this. For many Tawakalna crews, their first warning appears to have been the destruction of their armor as the 2nd ACR opened fire. In excursion scenario A, however, adequate warning is provided, enabling all the defenders' vehicles to be manned and ready when the attacker appears. As a result, the indirect effects of air supremacy cannot be exploited and the outcome is a far less one-sided firefight in spite of the U.S. technological advantage.

TECHNOLOGY AGAINST AN ALMOST ERROR-FREE DEFENSE. A defense that is even slightly less than error-free is extremely vulnerable to an attacker with

87. See, e.g., Scales, *Certain Victory*, pp. 261–262; Atkinson, *Crusade*, p. 443; U.S. News, *Triumph Without Victory*, p. 409.

advanced technology. Excursion scenarios B and C assume that only one of the Iraqi errors is left uncorrected.[88] In excursion B, terrain preparation is remedied, but the covering force still fails to alert the defenses; in excursion C, the covering force performs properly but the defenses are still poorly prepared. In both excursion scenarios, the attacker annihilates the defender at losses little higher than those of the historical base case (in excursion B, 5 simulated U.S. vehicle losses rather than the 2 of the base case; and in excursion C, only about 2).

This is because the potential lethality of advanced weapons is so high that an opportunity to use even a part of the Coalition's technology suite at full capacity can be decisive in itself. The M1A1's thermal sight offered a potential range advantage of more than 1600 meters in the sandstorm of the historical battle. If poor Iraqi position preparation allows the 2nd ACR to exploit this advantage, then it does not matter whether the victims are also surprised or not: the range advantage alone is more than enough to annihilate the defense even if the defenders are ready to fight from the outset. Coalition air supremacy induced many Iraqis to leave their vehicles unoccupied. If the Iraqis allow themselves to be surprised in this state, then the resulting chance to engage empty or unready targets through the critical early minutes of the attack is decisive in itself—whether the unready defenders are destroyed from 2000 meters away as they sit on the surface behind loose sand piles, or whether the shooting is done from point blank range against (unready) tanks that sit idly in better-dug, below-grade positions.

LESSER TECHNOLOGY AND THE CONSEQUENCES OF MISTAKES. Less sophisticated or less diverse offensive technology reduces the consequences of a defender's mistakes. The simulation results suggest that the less advanced the attacker's technology, the more errors the defender can tolerate and still avert disaster. Conversely, the more advanced the attacker's technology, the more nearly perfect the defense must be to avoid catastrophe. If the simulated Coalition attacker enjoys the full technology advantage that the Coalition did in the actual battle, virtually error-free defensive employment is required for the Iraqis to avert disaster, as can be seen by comparing the base case with excursion scenarios A, B, and C. But if the attacker's technology advantage is reduced, the Iraqis can accept some degree of error and still impose heavy

88. The Iraqis made many more mistakes in the actual battle than just the two considered here; the presence of only one error in excursion scenarios B and C thus implies a very dramatic (though still incomplete) improvement in Iraqi combat skills.

losses on the attacker. In excursion scenario D, for example, the attacker is denied the use of thermal sights, and it benefits only from the indirect effects of air supremacy, while the Iraqis commit only one of the two base case errors: they are assumed to obtain adequate warning, but they retain their problematic revetted vehicle positions. The resulting attacker casualties increase substantially relative to the historical base case (39 instead of 2).

But while the simulated Iraqis can tolerate somewhat more error against this lower-technology attack, they still cannot afford to make as many mistakes as the Iraqis actually did. In excursion scenario E, the attacker is again denied thermal sights, while the Iraqis commit both of the two base case errors; the resulting attacker losses are less than half the results that obtain when the Iraqis commit only one of the two errors (16 instead of 39).

If the Coalition technology advantage is reduced enough, however, then even a defense committing both base case errors can still impose severe costs on the attacker. In excursion scenario F, the attacker is denied both the thermal sight and air supremacy, while the Iraqis commit both errors assumed in the base case. The resulting casualties are substantially higher than those of the historical base case (i.e., 40 instead of 2).

OFFENSIVE EXECUTION AND TECHNOLOGY. Without skillful offensive execution, even advanced technology and a poorly handled defense cannot ensure low offensive casualties. Excursion scenario G posits a less skillful U.S. advance to contact, where the concentrated, well-coordinated formation of the historical base case is replaced with a strung-out alternative typical of poorly trained units.[89] All other properties of the base case are held constant, including the attacker's technological advantages and the defender's force employment errors. Even given the historical technical edge and defensive errors, simulated U.S. losses in the excursion scenario rise by more than a factor of ten (from 2 to more than 25 vehicles killed).

The reason for this is that the edge provided by reduced defender manning levels and long-range offensive target acquisition cannot compensate for an inability to mass fires. To provide victory at very low losses under the conditions of 73 Easting, the attacker must destroy most or all of the defending vehicles before closing to within visual range of the surviving alerted defenders

89. In particular, in this scenario 2nd ACR's actual, hybrid line-abreast–combat-vee formation (occupying a depth of 1500 meters for any given troop) was broken down into a straggling series of nine platoon-size lines abreast, separated in depth by three km each (and thus occupying a total of about 30 km depth for the ACR as a whole).

(and thus becoming exposed to accurate defensive fire). If the attacking formation is allowed to spread out during an extended approach march, however, as assumed in excursion scenario G, the result is a piecemeal commitment without the needed concentration. Arriving in penny packets, the attackers can still kill many defenders at long range, but they cannot kill enough to prevent survivors from extracting a toll as the small groups of attackers eventually come within visual range of the defenders.

IMPLICATIONS OF THE SIMULATION RESULTS

Taken together, the counterfactuals suggest two broad implications for casualty causation in the Gulf War. First, the skill-technology synergy explanation is consistent with the simulation results. Where defensive error provided openings for offensive technology to exploit, the result was offensive victory by an outnumbered attacker at very low losses. But without defensive mistakes, advanced technology could not prevent radically higher attacker casualties. And without offensive skill, even advanced technology and defensive error proved insufficient to hold attacker casualties down to anything near Gulf War levels. Moreover (for a skilled attacker), the more advanced the attacker's technology, the graver were the consequences of a given defender mistake, and the fewer the mistakes the defender could afford to make without courting disaster. In these simulation runs, technology thus acted as a wedge, driving apart the real military capability of skilled and unskilled forces, increasing the premium on skilled combat performance, and raising the standards for acceptable levels of skill on the part of armies faced with an advanced technology opponent.

Second, the simulation results are inconsistent with the linear multivariate model implicit in the current literature. A linear relationship between casualties, technology, offensive skill, and defensive skill would imply that the marginal effect of any one contributing cause would be about the same regardless of the presence or absence of the others, and that the marginal effects of each would be roughly independent of its level (that is, there should be no diminishing or increasing marginal returns: given two technologies with roughly equal independent effects on casualties, the results of introducing or removing one should be about the same whether the other is present or not). Yet the value of the attackers' weapon technology varied radically with the presence or absence of defensive errors and offensive skill. The effects of either of the tested defensive errors varied radically as a function of whether the other was also present. In the presence of two defensive errors, either thermal sights or air

supremacy produced about the same attacker losses, whereas with only one error present, the two technologies produced very different results. In these runs, the effects of the respective contributing causes thus do not simply cumulate linearly: they interact in a powerful, nonlinear manner.

Conclusions

There are important discrepancies between the historical record and the existing explanations of the Coalition's low loss rate. Between 600 and 2000 surviving Iraqi tanks and 610–2100 other armored vehicles actively fought back when the VII Corps and 1st and 2nd Marine Divisions struck the Republican Guard and Iraqi Army heavy divisions beginning on February 26. These engagements were mostly frontal assaults at often very modest local numerical odds. Under such conditions, a defending force this size could be expected, given historical effectiveness levels, to inflict much higher losses than the Coalition actually suffered in 1991. Arguments explaining an unprecedented loss rate in terms of broken Iraqi will, air attrition of Iraqi ground equipment, Coalition strategy, or Iraqi numerical inferiority thus face a considerable burden of contradictory evidence.

Explanations focused on skill or land warfare technology per se encounter difficulties of their own. The former implies that the 1991 skill imbalance must have been of unprecedented magnitude, a conclusion for which no adequate supporting evidence has been advanced to date. The latter implies that technologically diverse Coalition ground forces should have suffered different casualty levels (and in particular, that U.S. Marine or Bradley-equipped Army units without the technological overmatch typically ascribed to the M1A1 should have suffered heavily), yet they did not. Similarly, such an explanation implies that technologically similar ground forces should produce roughly similar results, whereas a comparison of Gulf War and National Training Center experience suggests quite the opposite.

Simple linear combinations of these effects might provide a somewhat better explanation, but multivariate linear explanations are no better than the sum of their univariate parts, and those parts seem quite weak here. Moreover, several basic assumptions of any linear model (e.g., weak interaction effects among explanatory variables and constant marginal effects with respect to level) are at odds with the results of counterfactual analyses conducted on the 73 Easting data base.

To account more fully for these properties of the war's conduct and results, I have argued that a nonlinear synergistic interaction between these variables caused the radical outcome of 1991. In particular, the Coalition's advanced technology made it possible to exploit Iraqi mistakes with unprecedented severity, enabling entire Republican Guard divisions to be annihilated in close combat with minimal losses.

In this, the breadth of the Coalition's technology advantage and the scope and diversity of Iraqi mistakes created many different possibilities for decisive exploitation. The thermal sights and 120 mm guns of the 2nd ACR's M1A1s could wipe out Iraqi armor that had been left above ground in ill-conceived sand revetments; alternatively, the indirect effects of Coalition air supremacy could interact with the poor performance of Iraqi covering forces to enable a 1960s-era Marine Corps M60A1s to destroy Iraqi tanks unoccupied before their surprised crews could remount. Many other such combinations existed, many of which would probably have enabled the Coalition to recapture the KTO with modest losses. Against a technology advantage as broad and as deep as the Coalition enjoyed in 1991, the Iraqis would have needed a virtually error-free defensive battle to have avoided disaster—and the Iraqi defense was anything but error-free.

If the Iraqis had attained Western standards of organizational performance, however, this analysis suggests that the results would have been radically different, even given the Coalition's advanced technology and high troop skills. Without errors to exploit, modern technology cannot provide anything like the lethality seen in 1991.

This in turn suggests a broader hypothesis: that in general, late-twentieth century technology may be magnifying the effects of skill differentials on the battlefield. If so, then a given skill imbalance may be much more important today than in the past, but combat outcomes for comparably skilled opponents may be little changed by new weaponry. The main effect of new technology may thus be to act as a wedge, gradually driving apart the real military power of states that can field skilled military organizations and those that cannot, but without changing fundamentally the outcomes of wars between equally skilled armies.

IMPLICATIONS FOR POLICY

Perhaps the Gulf War's broadest policy influence has been in persuading decision-makers that we may be on the verge of a revolution in military affairs

brought about by the radical impact of new technology on warfare. If so, then such a revolution would imply a wide variety of changes in the way the United States should equip and operate its forces, as well as the conditions under which those forces should be committed to battle and the results they could be expected to obtain.

Counterarguments have been advanced. In particular, it has been argued that the desert terrain of the KTO, the poor strategic decision-making of Saddam Hussein, or other idiosyncratic features of the Gulf War mean that Desert Storm is not repeatable, and thus that predictions of a revolution in warfare are premature.[90]

The analysis presented here, however, suggests a different conclusion than either of these. That is, I would agree that the Gulf War does provide important evidence for understanding the future of warfare, but that its meaning has been misinterpreted.

In particular, the role played by skill differentials—and especially the role of opposing error—has been seriously misunderstood. Arguments that the Gulf War was merely idiosyncratic often focus on Iraqi mistakes, but typically imply either that these were somehow unique or anomalous, or that such errors are themselves sufficient to explain the Gulf War outcome. Neither is the case. Many past armies have fought with skills apparently no better than the Iraqis', and there seems little reason to suppose that this cannot happen again. In fact, it could be argued that Iraqi performance in 1991 was representative of at least an important subset of potential future U.S. opponents.[91] And the interaction between skill and technology is powerful enough that if a future opponent fights a major regional contingency with no greater skills than the Iraqis', then the United States could well prevail again with very low losses, even if the terrain or geo-political context were very different from those of 1991. In 1996, U.S. technology advantages are many, U.S. personnel are highly skilled and resourceful, and it is possible to imagine a variety of plausible opposing

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90. See, e.g., Record, *Hollow Victory*, pp. 71–85, 135–136; Inman, Nye, Perry, and Smith, "U.S. Strategy After the Storm," p. 57; Mazarr, Snider, and Blackwell, *Desert Storm: The Gulf War and What We Learned*, pp. 3–5, 113.

91. See Stephen Biddle and Robert Zirkle, "Technology, Civil-Military Relations, and Warfare in the Developing World," *Journal of Strategic Studies*, Vol. 19, No. 2 (Summer 1996), pp. 171–212; Stephen Biddle, "Recent Trends in Armor, Infantry and Artillery Technology," in W. Thomas Wander, ed., *The Diffusion of Advanced Weaponry* (Washington, D.C.: American Association for the Advancement of Science, 1994); Eliot Cohen, "Distant Battles: Modern War in the Third World," *International Security*, Vol. 10, No. 4 (Spring 1986), pp. 143–171.

mistakes that such a combination could punish very severely even without the flat desert or elaborate Saudi Arabian logistical facilities of 1991.[92]

The Gulf War is thus not *sui generis*. But neither does it provide evidence that new technology (with or without doctrinal change) is creating a military revolution in which Gulf War–like results will become the norm for the major regional contingencies of the future. This is because no country can control the skills of its opponents, and these are likely to vary. Skills as low as the Iraqis' are probably more widespread than assumed by some; they are probably less widespread than needed for the Gulf War to provide a new paradigm for the future. If skill and technology interact as powerfully as suggested here, then skill variations are likely to become increasingly powerful drivers of military outcomes as technology advances, and this implies wider variance in future combat results, not a new pattern of quick, decisive results.

Rather than a revolution through information dominance and precision strike, what the Gulf War really suggests is thus a new ability to exploit mistakes. This, however, suggests very different policies. If new technology offered tremendous military power to any who acquired the new systems (and reformed their military doctrine to exploit them), this implies a powerful incentive for radical change: those who realize the full potential of the new era would enjoy enhanced security and influence, while those who do not do so would risk being left behind. This has led many "revolution" proponents to argue that the United States must, as quickly as possible, move away from such obsolescent "sunset systems" as heavy direct-fire ground forces, nonstealthy aircraft, or carrier battlegroups, and instead field a wholly new generation of deep precision-strike and information-warfare technologies. It is often argued that to do this, the United States should reorder near-term funding to preserve modernization (and redirect it away from incremental improvement of obsolescent weapon types), even at the expense of readiness or force structure.

92. For example, an offensive in mixed terrain using Soviet/East European-style tactics would require very skilled handling to avoid presenting decisive vulnerabilities to a skilled defender with advanced technology. Even where covering terrain is available, it is very hard to maintain the high operating tempos of standard Eastern military doctrine while keeping all necessary elements under cover. Improvising a lower-tempo offensive is itself no simple matter. While a highly skilled military might carry off either job, an unskilled or undisciplined one could easily produce congested roads full of easy PGM targets; command posts or ammunition dumps left too long in the open before finding concealment within reach of supported forces; or assault elements that spread out over varying terrain (presenting piecemeal attacks to sophisticated defenders), to cite just a few possibilities. Under such conditions, it is perfectly conceivable that a defender with advanced weapons could succeed at force levels supportable without a Saudi-scale logistical infrastructure.

Similarly, it is argued that current operational concepts centered on outdated equipment risk the fate of French defensive doctrine at the hands of German blitzkrieg concepts in 1940, and that the U.S. military must therefore adopt radically new doctrinal and organizational ideas.[93]

But if, as I have argued, modern warfare provides increasing penalties for error but little ability to prevail cheaply over skilled enemies, then both the benefits of change and the costs of continuity are much lower. If so, then rapid modernization increases U.S. capabilities mostly where they are already very strong, against unskilled opponents, but offers little where they are not, against those with better skills. The practical benefits would thus be much smaller than often argued. Conversely, the threat to U.S. forces if potential opponents acquire such technologies and use them against the United States is also much smaller as long as the U.S. military retains the quality of its people and its organizations. If one's own skills are high, one is insulated to an important degree against variations in opposing technology, even if one's own weapons change only incrementally.

Thus one should be wary of proposals to protect modernization funding at the expense of training and readiness accounts. A less-skilled military is more dangerous than less-advanced technology.[94] The decay of today's combat skills would not only forfeit the ability to exploit current technical advantages against less-skilled opponents, but it would also enable future challengers to turn the tables by acquiring better technology themselves and using it to its full potential against inadequately skilled Americans. Neither is a risk worth taking.

The Gulf War's failure to provide evidence for a revolution in military affairs thus has important ramifications for modernization policy and defense budget priorities. It also affects net assessment and force planning more generally.

Force planning is often done by analogy, especially in the public literature, using planning yardsticks derived from apparently comparable military experience in the past. In recent years, the Gulf War has been the most widely used

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93. See, e.g., Krepinevich, *The Bottom-Up Review*, pp. 30–49; Goure, "Is There a Military-Technical Revolution in America's Future?" pp. 175–192.

94. Some have argued that temporarily re-allocating funds from training to modernization would let U.S. forces recapitalize while threats are modest, then quickly re-establish combat skills later if and when needed. It is far from clear, however, that building a skilled organization is quicker than fielding new equipment. The determinants of organizational skill are poorly understood, making it especially risky to allow a highly competent military to decay now in the hopes that it can be quickly rebuilt later.

yardstick, and has influenced, explicitly or implicitly, even the most consequential official force planning analyses.[95] Yet the Gulf War outcome, and thus the adequacy of the forces used there, were powerfully influenced by the Iraqi military's limited skills. This creates two serious problems for force planners. First, requirements derived from a Gulf War yardstick could prove dangerously inadequate if applied against enemies more skilled than the Iraqis. But second, against unskilled enemies the Gulf force structure may *over*estimate future requirements: by the analysis above, it is at least plausible that a smaller Coalition force could still have prevailed at very low losses given the powerful interaction between skill and technology. Either way, for the Gulf War to provide a meaningful contribution to force planning requires a more discriminating treatment of opponents' skills than we have typically provided in the past; existing plans based on more conventional understandings of the war are potentially in serious error.

Most net assessments of foreign military capability turn on force size and weapon performance characteristics. The analysis above, however, suggests that neither feature provides much explanatory power for the actual combat outcome in 1991, at least not in the absence of a sound understanding of the skills of the organizations using them. This in turn suggests that net assessments carried out without such an understanding are subject to serious inaccuracies. Likewise, cost-effectiveness analyses of proposed weapon acquisitions can radically miscalculate the real military effectiveness of a new program if they do so without an explicit consideration of the interaction between the new system and the ways in which potential opponents might use their forces.

The Gulf War experience thus suggests that the global distribution of military skill and organizational performance is a pivotal issue for effective net assessment, weapon system cost-effectiveness analysis, and force planning, not to mention the debate over the prospects for revolutionary change in the nature of warfare itself. Yet the skills of national military organizations have not heretofore been the subject of systematic study. While anecdotal evaluations of individual armies have been compiled for generations, there have been few

95. It has been argued, for example, that the Defense Department's 1993 "Bottom-Up Review" of U.S. force structure was strongly influenced by the Gulf War in its judgment of force adequacy and threat type: see, e.g., Krepinevich, *The Bottom-Up Review*, pp. i, 22, 25–26, 49; Krepinevich, "Recasting Military Roles and Missions," *Issues in Science and Technology*, Vol. 11, No. 3 (Spring 1995), pp. 41–48, at p. 44. For other force planning exercises using the Gulf War as a yardstick, see Aspin, *An Approach to Sizing American Conventional Forces;* Bowie et al., *New Calculus;* Korb, "The Impact of the Persian Gulf War on Military Budgets and Force Structure," pp. 221–240; Collins, *Desert Shield and Desert Storm: Implications for Future U.S. Force Requirements.*

attempts to harness rigorous social scientific methods for the development of a deeper or more general understanding of the causes or distribution of such skills. And by contrast with the enormous effort, now spanning more than thirty years, to develop better understandings of the technical performance of weapons, the effort expended to date in understanding how those weapons interact with the skills of users and opponents to produce real combat results has been truly minuscule. A reallocation of intellectual effort is thus long overdue.

Of course, these conclusions are based on the technology of 1991 as observed in the Gulf War. The possibility cannot be excluded that future weapons might change the dynamics of battle in ways that render such conclusions invalid and bring about a revolution, perhaps of the type so often discussed. No analysis of the Gulf War can substitute for thoughtful speculation on the future. But the belief, now widespread, that radical change is upon us is based largely on the perceived experience of 1991, and that experience has been misread. Moreover, what we now know of the events of 1991 suggests that current net assessment and force planning methods may be significantly biased as a consequence of systematic misunderstanding of the role of skill in actual combat outcomes. The past can tell us only so much about the future, and it is always possible that it cannot tell us enough to provide a sound guide to current policy. But it is always a mistake to misunderstand the past, and we cannot possibly determine the proper relationship between current policy and recent history until we have got the history right.