Online Appendix for Melinda Haas and Keren Yarhi-Milo,
"To Disclose or Deceive? Sharing Secret Information Between Aligned States,"
International Security, Vol. 45, No. 3 (Winter 2020/21)

ISRAEL'S ATTACK ON THE OSIRAQ NUCLEAR REACTOR, 1981

Iraq had acquired its first nuclear facilities in the late 1960s. Later, in 1976, Iraq contracted with France to build a research reactor and associated laboratories. This reactor, named Osiraq, was built at al-Tuwaitha, ten miles southwest of Baghdad, with France providing the uranium for use in the reactor. Following the start of the Iran-Iraq War, Israeli intelligence confirmed that Iraq intended to produce weapons at Osiraq and decided to attack. Israel used a squadron of F-16 jets to destroy the reactor on June 7, 1981.[1]

Israel's attack on Iraq's nuclear reactor is a case demonstrating a concealment information-sharing strategy. In what follows we show that, consistent with our theoretical predictions about when Initiators turn to concealment, Israel had the military capabilities necessary to destroy Iraq's burgeoning nuclear facilities without U.S. involvement. Although the Israelis used American-built F-16 aircraft to carry out the airstrike, the United States had no technological advantage over Israel in successfully destroying the reactor. Second, Israel assessed that the U.S. would not be willing to join in an attack, especially after sending trial balloons to the U.S. ambassador to Israel about Israel's fear that Iraq could enter a "zone of immunity." Lastly, although Israel believed that the U.S. would have encouraged them not to attack, the United States' lack of attention to Israel's continued concerns about Iraq and Israel's defensive preparations led Israel to believe that an attack on the reactor would not result in significant deception costs if it concealed its Osiraq operation. Israel informed the U.S. of the Osiraq attack only after it was completed, taking the Reagan administration by surprise.

[1] Kenneth M. Pollack, *The Threatening Storm: The Case for Invading Iraq* (New York: Random House, 2002), 173.

Israel's Information-Sharing Dilemma. Israel had acted against Iraq's nuclear program as early as 1979, with reports that Mossad, Israel's national intelligence agency, was involved in an attempt to blow up the reactor core as it was being produced. Negotiations about a preventive strike began shortly thereafter, with Prime Minister Menachem Begin asking for an assessment of ways to destroy the reactor in November 1979. The United States understood the threat of a nuclear-armed Iraq, and it attempted to intervene with France and Italy, which were both assisting Saddam Hussein in his nuclear ambitions. However, the diplomatic route produced no results.[2]

Ten months before the raid, Begin called the U.S. ambassador to Israel, Samuel W. Lewis, expressing deep concern about the development of Iraqi reactor. Lewis and Begin had several conversations over the next three months about Begin's fear that Iraq would enter a "zone of immunity," a period after which Israel could destroy Osiraq only by unleashing a deadly cloud of fallout. But U.S. intelligence estimated that Iraq was two to three years from bringing the reactor online, rather than the one year estimated by Israel, and so the Carter administration attempted to assuage Begin's fears. We consider this period to be an Israeli trial balloon, in which Begin assessed U.S. opposition to an attack on the Iraqi reactor.

Lewis learned that Israeli military command was pressing Begin to take military action, and Lewis attempted to emphasize the importance of Osiraq to Israel in a transition memo following Reagan's election. Although he was assured that Osiraq was included in a key transition document, in fact, that document was overclassified and failed to gain notice of the transition team and filter its way up to key decision-makers.[3]

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[2] Chaim Herzog, *The Arab-Israeli Wars : War and Peace in the Middle East from the 1948 War of Independence to the Present* (London: Greenhill Books, 2004), 342.
[3] Bass, *A Surprise out of Zion?*, 30.

Concealing Plans from the United States. Perceived U.S. opposition played a large role in leading the Israelis to conceal the attack on Osiraq. In fact, Major General Yehoshua Saguy, chief of military intelligence, had opposed the attack since late 1979. At a late-1980 planning session, Saguy argued that an adverse reaction in Washington would be a more serious national security threat to Israel than was the Iraqi reactor.[4] Shortly after the raid, Israeli officials told Secretary of State Alexander Haig that they had "agonized" about whether to share their plans with the United States in advance. They ultimately decided against telling the United States because they believed the U.S. would have told Israel not to bomb. Haig wrote, "In this judgment, they were correct."[5]

Saguy continued to engage in intelligence exchanges with the United States, trying to push the U.S. to come to believe the Israelis' threat assessment. But Haig said that Saguy had not raised the issue of Osiraq with him, perhaps with a view that Haig's sympathy to Israel's security concerns came with a permissibility for military action. Lewis also found that Osiraq received little coverage in the press. Israel began finalizing its military plans, understanding that a lack of U.S. attention meant that U.S. diplomacy was not going to resolve their concerns. Lewis, consumed with worries about Syrian missiles in Lebanon, was not engaged with the Osiraq issue and knew of no communication with the U.S. intelligence community or military about planning the attack.[6]

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[4] Seymour M. Hersh, *The Samson Option: Israel's Nuclear Arsenal and American Foreign Policy* (New York: Random House, 1991), 10.
[5] Alexander Meigs Haig, *Caveat: Realism, Reagan, and Foreign Policy* (New York: Macmillan, 1984), 182.
[6] Warren Bass, *A Surprise out of Zion?: Case Studies in Israel's Decisions on Whether to Alert the United States to Preemptive and Preventive Strikes, from Suez to the Syrian Nuclear Reactor* (Santa Monica, CA: RAND, 2015), 32–33.

Begin decided the raid would take place on June 7, 1981, and a fear of leaks led the Israelis to engage in operational secrecy. The chief of military intelligence was not told of the mission until June 4, three days before it was scheduled to take place. Begin also had his cabinet come to his Jerusalem home at 5:00 p.m. on Sunday, June 7. During that time, fourteen American-built F-16 fighter aircraft flew through Jordanian and Saudi airspace toward Iraq. With no possibility of an emergency landing, the pilots flew low and evaded detection by U.S. Airborne Warning and Control Systems temporarily stationed in Saudi Arabia. Shortly before 7:00 p.m., the IDF reported that all planes had returned. The entire attack had been carried out in less than two minutes.[7]

That night, Begin relayed to Lewis on the phone: "Sam, I want you to get ahold of President Reagan immediately." Lewis sent a flash cable to Washington with Begin's message: "Today our air force carried out a raid on the atomic reactor near Baghdad. According to the reports of our pilots the target was completely destroyed. All our planes returned safely."[8] NSC officials replied to Lewis that Reagan was "extremely angry" with Begin for catching him unawares. Richard Allen, Reagan's National Security Advisor, has also written that the Reagan administration was genuinely surprised by the Osiraq raid. Even though U.S. technology "purchased for defensive purposes only" had been used, U.S. leaders had not been informed.[9] In fact, there is no evidence that Washington saw or understood Israeli defensive actions leading up to the strike, such as a cease of operations at the Dimona nuclear reactor and heightened intelligence overflights.[10]

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[7] Bass, 34; Alexandra Evans, "A Lesson from the 1981 Raid on Osirak," Wilson Center, June 8, 2017.
[8] Bass, *A Surprise out of Zion?*, 34.
[9] Hersh, *The Samson Option*, 8–12.
[10] Bass, *A Surprise out of Zion?*, 38.

The day following the attack, senior staff members held an Oval Office meeting and tried to assess the impact of the strike. Despite CIA Director William Casey's secret trip to Israel a few months earlier, Casey was embarrassed that his Israeli colleagues had not informed him in advance of the attack on Osiraq. Vice President George H. W. Bush; chief of staff, James Baker; and the president's aide, Michael Deaver, argued strongly for punitive actions against Israel, including taking back aircraft and delaying or canceling scheduled deliveries.[11] Ultimately, the Reagan administration sent a note to the Israeli government criticizing the raid and delayed shipment of several additional military aircraft "as a show of [] displeasure."[12]

Nevertheless, consistent with Israeli expectations, deception costs were short-lived as "Reagan himself quickly got over his initial shock that Begin would take so major a step without consulting him."[13] In a meeting with the Israeli Ambassador on June 11, Reagan admitted that he "was caught by surprise" but reassured the Ambassador that "we are not reevaluating our relations with Israel; we are not engage in any reassessment of our relationship" and that "we are *not* retreating on our basic commitment to the security of Israel," reiterating his intentions "to maintain Israel's qualitative military edge."

One alternative explanation is that Israel engaged in concealment out of a concern for domestic politics. Domestically, there was some opposition to the operation by opposition leaders and by officials that knew about its preparations, but it subsided a short time after the success of the attack.[14] During this time, political factors within Israel affected many foreign policy directives. According to Melvin Friedlander, "because Begin enjoyed only a narrow

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[11] Richard V. Allen, "Reagan's Secure Line," *New York Times*, June 6, 2010.
[12] Ronald Reagan, *An American Life* (New York: Simon and Schuster, 1990), 413.
[13] Bass, *A Surprise out of Zion?*, 42.
[14] Shelomoh Naḳdimon, *First Strike : The Exclusive Story of How Israel Foiled Iraq's Attempt to Get the Bomb* (New York: Summit Books, 1987).

majority in the Knesset those right-wing groups and their representatives in the cabinet possessed a virtual veto over government decisions."[15] Israel also had a Knesset election scheduled for November 1981. The Labor party, led by Shimon Peres, was gaining ground on Begin's Likud party and by May 1981, Begin lagged behind Peres in polls. But as the evidence suggests, avoiding a domestic political debate was not the primary reason for concealment. Moreover, as can be seen in the al Kibar case, Israel could have easily informed the United States and still maintained operational secrecy and kept the domestic audience in the dark.

JOINT STUXNET CYBERATTACK AGAINST IRAN, 2008

Iran had pursued a nuclear program since the 1970s, but in 2002 it revealed a secretly constructed uranium enrichment facility. In 2003, IAEA inspectors found weapons-grade uranium particles in samples taken from the Natanz fuel enrichment plant, and the CIA and Mossad exchanged ideas for damaging Iran's nuclear infrastructure. Tensions decreased when Iranian officials agreed to suspend enrichment in 2003 and 2004. In June 2006, the UN Security Council demanded that Iran suspend all uranium enrichment programs, but after noncompliance through December 2006, the Security Council imposed sanctions.[16]

After Iran withdrew from its suspension agreement, intelligence officials in Israel and the United States colluded over a cyber operation called "Olympic Games." Based on digital forensics after the Stuxnet attack was detected, preliminary work was conducted as early as November 2005. In late 2007, President Bush requested and received from Congress $400

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[15] Melvin A. Friedlander, *Sadat and Begin : The Domestic Politics of Peacemaking* (Boulder, Colo: Westview Press, 1983), 310.
[16] Dan Raviv and Yossi Melman, *Spies Against Armageddon: Inside Israel's Secret Wars* (Levant Books, 2012), 9; Kim Zetter, *Countdown to Zero Day: Stuxnet and the Launch of the World's First Digital Weapon* (New York: Crown Publishers, 2014), 190–91.

million to fund covert operations aimed at Iran's nuclear program and efforts to sabotage equipment and facilities used in the nuclear program.[17] While President Bush was concerned with the escalatory potential of on-the-ground covert attacks, he thought a cyberattack would pose fewer risks. This cyberattack resulted in the "Stuxnet" computer worm, which was designed to disrupt the computerized control system that ran the centrifuges and to slow down and speed up the centrifuge motors, tearing them apart. Stuxnet also provided false feedback to operators so its workings would be imperceptible, and it went undetected until 2010.[18]

Under our theoretical expectations for collusion, there is some evidence to suggest that Israel did need the United States; the Olympic Games operation was one of the first major cyberattacks to physical infrastructure,[19] requiring intelligence and technical expertise only possessed by the NSA. Israel was also confident that the United States would be willing to serve a supportive role because it had both invested in previous anti-proliferation measures against Iran, and a cyberattack provided a limited use of force more palatable to U.S. leaders.

Joint Interest in a Covert Cyberattack. In May 2008, during President Bush's visit to Israel at the end of his second term, the Israelis requested U.S. support and endorsement for an air strike against Natanz. Meir Dagan, the head of Mossad, had tried for years to prevent Prime Minister Benjamin Netanyahu from using an air attack against Iran. Dagan calculated that Iran's program would be driven further underground by such an attack, and that "[i]t would unite the Iranian

[17] Zetter, *Countdown to Zero Day*, 194, 305, 309.
[18] Kim Zetter and Huib Modderkolk, "Revealed: How a Secret Dutch Mole Aided the U.S.-Israeli Stuxnet Cyberattack on Iran," Yahoo News, September 2, 2019.
[19] We consider this cyberattack to fall under the limited uses of military force to which our theory applies, particularly in the Stuxnet case, because these cyber operations had kinetic effects similar to that resulting from traditional use of military force.

people behind the project and enable Khamenei to say that he must get himself an atom bomb to defend Iran against Israeli aggression."[20]

Not only were there strategic risks, but an attack on Iran was tactically riskier than earlier attacks on al Kibar and Osiraq, when the Israelis had targeted a single, aboveground facility that was not heavily fortified. In Syria, the target was close enough that pilots could strike and return home. But a strike against Iran would require refueling and flying through Middle Eastern airspace. Furthermore, Iran's nuclear facilities were decentralized and underground, with a uranium conversion plant at Esfahan separate from the enrichment plant at Natanz. This cyberattack also differed from Israel's later push for an attack on Iran's nuclear program, discussed above, by the weaponry available. In mid-2007, Israel had secured an agreement to obtain a new generation of bunker-busting bombs from the U.S.—said to be ten times more powerful than the previous generation and capable of breaking through cement and penetrating deep underground. But the new bombs were not expected to be ready until 2009 or 2010, and there was no guarantee at this early stage that they would be capable of destroying Natanz.[21]

The U.S. was equally interested in slowing the Iranians and forcing them to the bargaining table, but the Bush administration sought to discourage Israel from carrying out Netanyahu's threats of bombing Iran's facilities. Not only had Israel shown that it was willing and able to bomb nuclear programs in Syria and Iraq, but Israeli officials also proposed assassinations of Iranian scientists and supporting armed opposition groups inside Iran. Olympic Games was a way to prevent a bombing from escalating into a regional war.[22]

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[20] David E. Sanger, *The Perfect Weapon: War, Sabotage, and Fear in the Cyber Age* (New York: Crown/Archetype, 2018), 39.
[21] Zetter, *Countdown to Zero Day*, 193, 196 n.16.
[22] Sanger, *The Perfect Weapon*, 35–36; Adam Segal, *The Hacked World Order: How Nations Fight, Trade, Maneuver, and Manipulate in the Digital Age* (New York: PublicAffairs, 2016), 2;

Division of Labor in Stuxnet Development. The joint interest in damaging the Iranian facilities and the singular expertise and intelligence of each state produced close sharing of information between NSA programmers and IDF's Unit 8200. Analysts attributed the code to two separate teams, but it is unknown whether the U.S. and Israel worked together, or whether the Israelis worked on one portion while the U.S. handled the worm's payload. Analysts found stylistic and substantive evidence of Israel's role in the code writing, and there was a U.S. "calling card"—an expiration date, after which the code would stop functioning.

Further cooperation in the Stuxnet project can be seen in the research both sides conducted into the details of Iran's nuclear reactor system. In one of the buildings at Dimona, Israel's nuclear facility in the Negev desert, Israel set up old centrifuges similar to those at Natanz on which to test the Stuxnet worm. The U.S. assembled similar centrifuges at Oak Ridge National Laboratory in Tennessee to determine how long enrichment for a bomb would take.[23]

In response to the odd malfunctions at Natanz, Iran claimed that "the United States and Israel were behind the attack. But neither government had ever uttered an admission, emblematic of the reflexive secrecy they wrapped around all cyber operations." The operation was ultimately revealed when the Stuxnet worm escaped Iran's nuclear system in the summer of 2010 and replicated itself in computer systems around the world. In January 2011, the *New York Times* attributed the Stuxnet attack to the U.S. and Israel, with help from the Germans and the British (and as more recently revealed, the Dutch).[24]

David Crist, *The Twilight War: The Secret History of America's Thirty-Year Conflict with Iran* (New York, N.Y.: Penguin Press, 2012), 550.

[23] Sanger, *The Perfect Weapon*, 39; Raviv and Melman, *Spies Against Armageddon*; Zetter and Modderkolk, "Revealed"; Zetter, *Countdown to Zero Day*, 202, 315.

[24] Sanger, *The Perfect Weapon*, 24–25, 36; William J. Broad, John Markoff, and David E. Sanger, "Stuxnet Worm Used Against Iran Was Tested in Israel," *New York Times*, January 15, 2011.