A Social-Constructivist Analysis of Israel's Iron Dome

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Samuel James Falls

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On my honor as a student, I have neither given nor received unauthorized aid on this assignment

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Advisor

Joshua Earle, Department of Engineering and Society

Introduction

Though human habitation in the Levant stretches back at least 1.5 million years (Martínez-Navarro, 2009), the relevant background for this paper begins in the early 20th century with increased persecution of Jewish people worldwide, leading many to migrate to that region. Rising tensions led to violence between the these immigrants and the native inhabitants, who were mostly Muslim and ethnically Arab, and the then British Mandate of Palestine was partitioned into Jewish and Arab sectors in 1948. This initially sparked more violence, with the local Palestinians being aided by a coalition of Arab states including Jordan and Egypt (Britannica, 2024). Jewish forces expanded their control from 55% of the original Mandate (the territory they were promised) to 78% (Raz, 2015), but Jordan came to occupy the West Bank and Egypt came to occupy the Gaza Strip.

Just under twenty years later, in July of 1967, Israel launched a surprise attack on Egyptian forces in the Sinai peninsula. Leaders in the Israeli government claimed they had no territorial ambitions, but when the Israel Defense Force (IDF) successfully occupied Gaza, the entire Sinai peninsula, the West Bank, and the Golan Heights (formerly governed by Syria), they made no attempts to negotiate for peace. Instead, Prime Minister Levi Eshkol's government did their best to maintain the new status quo while appearing to be open to negotiation in order to appease the American government, who were their main weapons supplier. Eshkol's government sought to retain their territorial acquisitions minus the populations living there, going so far as to delay wartime measures like the destruction of bridges in order to allow the Arabs and Palestinians to flee. Soldiers used megaphones to advise Palestinians to leave the west bank "or face the consequences," and fired guns over the Palestinians' heads. Those that chose to remain found themselves living under military occupation. Within less than a month, Jewish settlements

began to be established across the occupied territories (Raz). Israel returned the Sinai Peninsula to Egypt after the Yom Kippur War in 1973, but retained control of Gaza, the West Bank, and the Golan Heights.

Hamas, the organization which currently controls the Gaza strip, was (somewhat inadvertently) founded by the Muslim Brotherhood (an Islamist organization) over the course of several months between 1987 and 1988, in the wake of the first intifada (uprising). When popular uprisings against the Israeli government began, the Brotherhood (which had been criticized for prioritizing Islamization of Palestine over liberation) established Hamas "as an ostensibly separate organization," which could be promoted to be a part of the Brotherhood only if the intifada continued (Abu-Amr, 1993). In the intervening decades, Hamas eclipsed the Brotherhood in power and prominence, and has been the de-facto government of the Gaza strip since 2006, when it won a bare plurality of the vote and then began to execute members of Fatah, its main rival party. It is also worth noting that since the median age in the Gaza strip is 18, most Palestinians living there today were not alive at the time of this election (Kaplan, 2023).

Israel's first forays into missile defense began in 1986, when the state signed a memorandum alongside the United States to participate in U.S. president Ronald Reagan's strategic defense initiative. However, these efforts were directed towards other state-level actors such as the government of Iraq during the gulf war (Dombrowski, 2013). Hamas did not begin to manufacture[1] missiles until June 2001, when Nidal Farhat and Tito Mas'ud manufactured the first Qassam I rocket. Four months later, the first Hamas rocket landed outside of the Gaza strip. Despite these 'homemade' rockets being utterly lacking in accuracy or targeting capabilities, the persistent terror they have created has had a serious psychological impact on Israeli civilians, and

[1] I use 'manufacture' here because that is what Ahmed Qasem Hussein states. I have found no claims that Hamas did or did not use missiles manufactured by other organizations or states before this date

their use has therefore been a key bargaining chip in truce negotiations (Hussein, 2021). In response to this threat, Rafael Advanced Defense Systems (an Israeli defense company) began development of the defense system known as Iron Dome in February of 2007, and the IDF deployed it by April of 2011 (Sharp, 2012).

Since then, Iron Dome has had three major deployments. In November 2012 Hamas launched approximately 1,500 rockets into Israel, 600 of which were on target, 85% of which were intercepted by Iron Dome. In July 2014, Israel launched a ground offensive into Gaza, which led to the deaths of 2,100 Palestinians. During this offensive, Hamas launched approximately 4,500 rockets into Israeli territory, 800 of which were identified as threats, 90% of which were shot down by Iron Dome. During the October 7th attacks of 2023, Hamas launched 2,200 rockets in just twenty minutes, overwhelming the Iron Dome's interceptor batteries to kill many Israeli civilians (Ray, 2024).

Iron Dome is the core subject of this paper. It is an intelligent defense system employed by the IDF to detect and shoot down rockets and missiles (Johannsen, 2011), consisting of a radar system to detect incoming rockets, a control center, and a battery of interceptor missiles. When the radar detects a missile, the control center evaluates where that projectile is likely to land. If the computer determines that the rocket or missile is likely to strike an important target, an interceptor is launched to detonate the missile in mid-air (Bonsignore, 2008).

I am interested in exploring the morality of military technologies that are, at least in theory, "mechanism[s] of pure defense," (IDF Editorial Team, 2023). Through a primarily consequentialist framework, I evaluate the impact of Iron Dome on all people it affects. I examine the history of and behind the Iron Dome missile defense system through the lens of Bijker and Pinch's Social Construction of Technology. The Methods section consists of an

overview of the SCoT framework and a summary of my sources and research methods. In the analysis section, I use my sources to apply the Social Construction of Technology framework to Iron Dome, looking to uncover the social forces that have influenced its development, construction, and deployment, and which may yet influence its future.

Methods

The primary framework for this paper is Bijker and Pinch's Social Construction of Technology (1987), which analyzes the development of technology as a social phenomenon. They emphasize that technological development is not a linear, deterministic process of mathematical optimization, but rather a series of choices influenced by culture as much or more than physics.

In this paper, I synthesize primary and secondary sources on Iron Dome and on distinct cultural groups' attitudes towards Iron Dome in order to better understand both the history of its development and how it might develop in the future. Bijker and Pinch describe technological development as a process of "variation and selection" analogous to biological evolution. Inventors produce variations on existing designs which succeed or fail depending on sociocultural and technical conditions. Through the three-step process outlined below, I explore the conditions that led to the success (or at least selection) of Iron Dome over other solutions.

I have broken Bijker and Pinch's process into three stages, based on their analysis of bicycles. The first stage is to identify the relevant social groups. Relevant social groups are any groups that influence the development of the technology (or, for my paper, are influenced by it). They are distinguished from one another by the meaning they ascribe to the technology. For this paper, the relevant social groups are the Israel Defense Forces (and the Israeli government as a whole), Israeli civilians, Hamas, Palestinian civilians, and the companies that manufacture Iron Dome. The manufacturers and the IDF, as the producers and consumers, have the most direct influence over the technology. Israeli civilians have influence over the IDF through the democratic process. Hamas has of course played a crucial role in the development of Iron Dome through their opposition to the IDF. Palestinian civilians have some degree of influence over both

Hamas and the Israeli government, but much less than Israeli civilians. This paper is especially concerned with the influence of Iron Dome on Palestinians as well as the influence of Palestinians on Iron Dome.

The second stage is to identify the "problems" each social group has "in respect to the artifact." Bijker and Pinch explain that technologies are developed as solutions to problems. When social groups have problems with existing technology, they attempt to solve those problems by modifying the technology (technological solutions) or their own culture (social solutions). I consider both the problems that Iron Dome was designed to solve and new problems posed by the current system. In order to consider the alternative perspectives of Hamas and Palestinian civilians, I also construct a sort of mirror-framework, where Iron Dome itself may be the problem, or at least a part of it. I consider what potential problems Hamas' Qassam Rockets (which Iron Dome was designed to shoot down) are meant to solve, and how Iron Dome influences Hamas' choice of alternative technological or social solutions.

The final stage is to examine potential solutions to these problems, which can be technological or social. In the case of the bicycle, Bijker and Pinch focused on historical solutions to problems. I examine both past solutions (which will form my analysis of the history of Iron Dome) and potential future solutions (which will shape my views on its future).

In the analysis section, I examine academic studies as well as primary sources published by these social groups to determine what problems they perceived before the creation of Iron Dome, in respect to the construction of Iron Dome, and in regards to its current implementations. I then evaluate Iron Dome as a solution as well as other potential solutions and modifications, both sociological and technological.

Analysis

Literature Review

I begin my analysis with a literature review, starting with Israeli perspectives. These sources predominate in western circles, so it is especially important to evaluate them for biases, but the biases themselves can often be a useful source of information.

The most obvious answer to the question "What problem does Iron Dome solve?" is "the deaths of civilians." My first source certainly holds with this response. In *The Irony of the Iron Dome: Intelligent Defense Systems, Law, and Security* (2016), Ayal Feinberg and Daphne Richemond-Barak argue that international humanitarian law (IHL) should be amended to encourage the development of "intelligent defense systems" such as Iron Dome. They acknowledge that this would be a departure from the standard domain of IHL, which typically focuses on requiring belligerents to protect "the other side," not their own people (pg 470). They also acknowledge that the deployment of defense systems can lead to "certain types of conflict escalation," (pg 474). However, Feinberg and Richemond-Barak ultimately press for "incentivizing" intelligent defense systems because they serve humanitarian law's primary goal: "protecting civilians from the conduct of hostilities," (pg 474). This use makes intuitive sense, and I would certainly not be inclined to argue for the immediate dismantling of intelligent defense systems. However, beyond the acknowledgement of their potential to escalate conflicts in a general sense, Feinberg and Richemond-Barak do not consider the direct or indirect effects of intelligent defense systems on civilians of opponent nations. Despite noting that IHL is typically focused on such civilians, their paper does not address any potential impacts that Iron Dome may have on Palestinian civilians.

Interestingly, a number of sources actually cite the saving of (Israeli) civilian lives as leading to a problem with the current implementation of Iron Dome. In *Iron dome and jus ad bellum proportionality* (2022), Shelli Aviv Yeini argues that many of the accusations of disproportionality against the Israel Defense Forces have stemmed from a misunderstanding or misinterpretation of the concept of proportionality in international law. Referring to commonly cited figures showing that the death toll of Palestinian civilians is much higher than that of Israeli civilians, she argues that Iron Dome has exacerbated this disparity by vastly reducing casualties from rocket and missile attacks by Hamas.

Yeini's paper reviews the history of proportionality in international law, including several alternate definitions (such as "proportionality to threats," "proportionality against inflicted injury," and "that which is required to achieve a state's objective"), but ultimately claims that while there is a "variance in understandings of proportionality" amongst scholars, "most contemporary scholars do not support quantitative proportionality," (pg 129). Instead, the focus is on whether or not a state's ends are legitimate or whether their actions are proportionate to the threat posed. A quantitative approach, Yeini argues, would lead to "tit-for-tat" violence and revenge-based justifications for conflict (pg 146). She acknowledges the potential of a "narrow quantitative proportionality analysis," but only if it is couched in a "broader qualitative test," (pg 155).

The conclusion drawn from these arguments is a double-edged sword. On one hand, Yeini points out that the Israeli government has frequently used misunderstandings of proportionality as opportunities to drag arguments into the territory of semantics and away from more relevant issues. On the other hand, the limited acknowledgement of the potential of a "narrow quantitative" assessment feels like an attempt to dismiss the reality of the disparity in

the death toll. My natural inclination is to argue that the protection AADS provide requires the nation states that employ them to exercise a more cautious hand in preemptive operations justified as self-defense. Yeini acknowledges that "[t]he absence of casualties on one side compared with the multiple casualties on the other may lead to the conclusion that the actions taken in self-defense were not proportional," but claims that "this analysis is overly simplistic" because AADS like Iron Dome are fallible (pg 150). Because Iron Dome can be overwhelmed (by a barrage involving many rockets launched simultaneously, for example), Israel must still act in self defense. This is an effective argument against the idea that Iron Dome should require Israel to sit by and passively accept rocket- and mortar-fire, but it does not address whether Iron Dome alters what self-defense actions the IDF should take.

Of course, Yeini does not argue that the 'obfuscation of proportionality' problem is reason enough to decommission Iron Dome. In the context of SCoT, she is advocating a "moral" (Bijker, 1987) solution: proportionality in conflicts ought not to be judged (at least solely) upon quantitative measures such as casualties. This is potentially an interesting example of how artifacts can lead to social or cultural change; though Yeini grounds her arguments in historical precedent, the moral framework she promotes is still shaped by technological capabilities.

Yousef Munayyer writes extensively on western media portrayal of the Israel-Palestine conflict in *Crisis Moments: Shifting the Discourse* (2014). He argues that because Palestinian issues are so distant to most westerners, western opinions are primarily shaped by the sudden spikes in news coverage during "crisis moments." Munayyer notes that many more news stories are dedicated to Qassam rockets and Israeli defense technologies such as Iron Dome than the "tons of ordnance Israel fired into Gaza." Iron Dome is clearly serving a secondary purpose by

drawing attention away from offensive weapons and emphasizing the perspective of Israel as on the defense.

Munayyer draws our attention to the fact that Iron Dome has uses outside of its direct military application. The social groups in control of it likely realize that it is an effective tool of propaganda. This is because it is an example of highly advanced military technology being employed expressly for the purposes of defense, which is good for the optics of the IDF as well as the corporations that manufacture Iron Dome. In particular, we find sentences such as "RAFAEL's IRON DOME™ is the world's most deployed missile defense system, with more than 2,000 interceptions and a success rate greater than 90%," on RAFAEL's (an Israeli state-owned defense corporation) website and "The Iron Dome is a mechanism of pure defense, and has absolutely no attack capabilities. It is a purely noble invention and is crucial for the safety of Israel's civilians," on the IDF's. It is clearly easier to talk about interceptor missiles than regular, offensive ones.

I have established that, from the perspective of its manufacturers and users, Iron Dome solves problems such as civilian casualties and public relations difficulties, as well as potentially creating difficulties in public relations by distorting the appearance of proportionality. However, Social Construction of Technology, when properly employed, extends beyond the users and producers to encompass all groups for whom the technology has taken on meaning (Bijker). In order to fully understand how technologies such as Iron Dome develop, it is necessary to understand those that oppose them.

To this point, I explore Hamas' interpretation of the Iron Dome technology. Margret Johannsen's *A Balance of Fear: Asymmetric Threats and Tit-for-Tat Strategies in Gaza* (2011) is particularly useful in this endeavor. Her most important point (at least to this paper) is that the

Qassam rockets fired by Hamas into Israel, which are the primary targets of Iron Dome, "have virtually no value as war-fighting weapons," (pg 47). This is because they are unguided and therefore inaccurate. In fact, most "fall… into uninhabited areas without causing harm," (pg 46). Johannsen's key insight, then, is that the Qassam rockets' primary purpose is to "erode the sense of security" of Israeli civilians living near Gaza (pg 47). This means that Iron Dome cannot counteract the Qassam rockets' primary purpose, because it cannot ever be 100% effective. Civilian life is still disrupted by the need to rush to shelters, and the psychological effects of being threatened by rockets are still in place.

Johannsen also notes that the difference in cost between the Iron Dome and the Qassam rockets limits Iron Dome's effectiveness. A single interception by Iron Dome is estimated to cost at least one hundred times as much as the rocket it intercepts.[2] Though the IDF's funding certainly exceeds Hamas', this disparity is so extraordinary that it is hard to imagine Iron Dome as a permanent solution. The selective targeting of only the rockets which are expected to land in populated areas is helpful, but insufficient; for example, over the course of 12 days in 2021, the IDF claimed that about two thirds of the more than 4000 rockets launched failed to target populated or built-up areas (Pfeffer, 2021). At that rate, three Qassam rockets still cost a lot less than one Iron Dome interceptor.

Applying a Social Construction of Technology Analysis

After identifying the relevant social groups, the next step is to identify the problems each social group has in respect to the artifact. This was in many respects the primary goal of the literature view, but I have provided a summary for clarity.

[2] Mark Episkopos (2020) gives a price range of $100,000 to $150,000 per interception. Yonah Bob (2021) estimates that the cost of a Qassam Rocket is between $500 and $800. Taking the lower bound of the cost of interception ($100,000) and rounding the Qassam estimate up to $1,000 gives a factor of 100.

Firstly, both the Israel Defense Forces and Israeli civilians view Iron Dome as a solution to the acts of terror perpetrated by Hamas. Secondly, news coverage of Iron Dome portrays the IDF (and the weapons manufacturers who produce Iron Dome) as primarily defensive organizations, mitigating if not 'solving' these groups' challenges with public relations. Conversely, Iron Dome presents a problem for Palestinian civilians in this way because it draws attention away from acts of violence perpetrated by the IDF.

Hamas developed missiles such as the Qassam rockets as a 'solution' to the problem of the Israel Defense Forces' ability to act against Hamas (and Palestinian civilians) with impunity. These rockets are, of course, not defensive capabilities or protection in a direct sense, but rather acts of revenge, primarily psychological. Because of this, Iron Dome's ability to counter Hamas' goals is much less than one might expect from its interception rates. Any technological solution which is less than 100% effective is unlikely to deter Hamas from attempting acts of terror.

It seems unlikely to me that these facts escape the notice of the Israeli government. Presumably, their awareness of the fact that Iron Dome will not stop the attacks is what has led to their military operations in Gaza, at least on paper. But another goal is worth considering. Though Netanyahu, the current prime minister, has avoided the topic, governmental figures under him have asserted that the threat Hamas poses is useful to the Israeli government. By making sure that Palestinian leadership is fractured (between Hamas, which governs Gaza, and the Palestinian Authority, which governs the West Bank), and that one of the major factions is designated as a terrorist organization, Netanyahu can avoid negotiations by claiming he has no legitimate partner with whom to negotiate. Bezalel Smotrich (who is currently the Minister of Finance) put it very bluntly back in 2015: "The Palestinian Authority is a burden. Hamas is an asset," (Mazzetti, 2023). To this end, the Israeli government had allowed the government of

Qatar to send millions of dollars in aid to Gaza for years (Mazzetti). The Iron Dome's inadequacy in protecting Israeli civilians is more evidence that that might not be their government's priority.

Conclusion

Iron Dome was developed to serve multiple purposes. It protects Israeli civilians from Hamas, but also draws attention away from the Israel Defense Forces' acts of aggression by highlighting those of Hamas. Conversely, it exacerbates the IDF's public relations crisis by reducing Israeli civilian casualties, making their efforts seem more disproportionate. Hamas views Iron Dome as hindering their attempts to threaten Israeli civilians, but not entirely. The defense system can be overwhelmed by barrages of missiles, and if even one occasionally gets through, an atmosphere of terror is still generated.

As a whole, the Iron Dome's success is best described as 'partial.' It is certainly effective at reducing Israeli civilian casualties from rocket- and mortar-fire. However, civilian casualties are only an instrumental goal for Hamas. The group's primary goal is to punish Israeli civilians through terror and disruption, which Iron Dome cannot completely counteract. For this reason, Iron Dome is unlikely to persuade Hamas (or whatever organizations may replace it in the future) to desist.

The fact that Iron Dome can never fully address the problem it was ostensibly built to solve is noteworthy. At best, it is a stopgap measure until better solutions can be developed. At worst, those in direct control of the technology (the IDF and the manufacturing corporations) have separate goals that are a higher priority for them. Either way, it is clear that alternative solutions must be sought. A social solution (namely, a ceasefire and ultimately, a long term peace process) is clearly necessary. Easier said than done.

Returning to the question of the Iron Dome, however, a couple salient points reveal themselves. One, we should carefully examine technological artifacts to determine their

effectiveness in regards to their stated purpose. Cross-referencing an artifact's behavior with the goals and motivations of its proponents may reveal secondary purposes.

Two, we should be wary of any attempted technological solutions to social problems. This is especially true when the social problem is a violent conflict or even a war. By presenting as a shield, Iron Dome attempts to create an illusion of safety and distance for Israeli civilians who live only tens of kilometers from the conflict. If we trust in superior technology to seal away victims of oppression, eventual disappointment is the best-case scenario. Success, for however long it lasts, maintains the oppression. Social problems require social solutions.

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