

**Motivating Operatives
for Suicide Missions and Conventional Terrorist Attacks**

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Abstract

We investigate the problem of motivating terrorist operatives for suicide missions and conventional terrorist attacks when operatives have either self-interested or social preferences which are not observable by the terrorist organization. We characterize the screening mechanism for selecting operatives according to their social preferences and determine under what conditions a terrorist group will prefer to utilize suicide versus conventional tactics. For example, when operatives are intrinsically-motivated and likely to be represented in the pool of potential recruits, a terrorist organization will be more likely to employ suicide attacks as its sole tactic of choice.

Key Words: suicide missions; terrorism; social preferences; screening

1. Introduction

At least since Lebanon in the early 1980's, suicide attacks have been part of a terrorist organization's tactics. Despite popular perception however, suicide terrorism is not solely the province of religious terrorist organizations. For example, according to Merari (1998), most suicide attacks in Lebanon between 1983 and 1986 were carried out by secular groups: of the thirty-one incidents, only seven were conducted by fundamentalist groups. Nor do terrorist organizations exclusively employ suicide tactics. Even al-Qaeda and its affiliates resort to the occasional use of non-suicide attacks, as was the case for the first World Trade Center bombing, the Al-Khobar massacres in Saudi Arabia, and the 2007 car bomb attempts in Piccadilly Circus and Trafalgar Square.

Given that groups as varied as the Liberation Tigers of Tamil Eelam (LTTE) and Hezbollah have periodically employed suicide tactics over the last thirty years, it is perhaps not surprising that a variety of explanations have been put forward to explain their use. One rationale is their perceived effectiveness in coercing adversaries into meeting the terrorist group's demands (Crenshaw, 2007). For example, Pape (2005) argues that the objective of most suicide terrorism is to get rid of foreign occupation. As the author claims, insofar as most attacks are against democracies, groups utilizing suicide tactics are more likely to achieve their goals since democracies are likely to change their policies given their natural sensitivity to terrorist events. The Lebanese experience is illustrative as the US and France removed troops from Beirut in response to suicide attacks. Another rationale for its use is the suicide attack's potential capability to successfully destroy its target, irrespective of whether the objective is to orchestrate a suicide bombing in a restricted area, a mass killing, or the assassination of a key political figure. Moreover, a suicide attack may be chosen over a conventional one when the former

seems to be more likely to succeed than the latter (Berman and Laitin, 2004).¹

Suicide attacks can also act as a signal of the depth of a group's resolve and may additionally serve as an instrument to attract further recruits and support. Although suicide attacks and the specific targeting of civilians can backfire and appall international audiences, as is believed to occur in the aftermath of the suicide bombings conducted by Chechen separatists inside Russia, a group may nevertheless feel compelled to utilize the tactic (perhaps even as a last resort) in order to demonstrate the group's relevance (Kalyvas and Sanchez-Cuenca, 2005). As a showcase of the group's commitment and message, as well as the underlying emphasis that its impact may have on a targeted audience, perhaps as a shock tactic, suicide missions may also be a means for a group to extract revenge or to retaliate for perceived past wrongs. They may also be used to prevent reconciliation of its supporters with its adversary and to prompt the latter into engaging in acts of repression that are self-defeating.

If suicide missions are as instrumental in achieving a terrorist group's goals as conventional attacks, a question arises as to how such groups recruit individuals willing to carry out suicide missions just as some individuals are willing to carry out other forms of extreme violence. Although the answer to this question can be addressed in a variety of ways², for our purposes, we focus on the types of operatives that groups can choose from and the implications this has for the allocation of tasks within a terrorist organization. In order to concentrate on this particular question, we emphasize three main features. The first is that the terrorist organization can enlist operatives to conduct either conventional or suicide attacks. Secondly, we assume there is a degree of substitutability between suicide and conventional tactics, albeit at differential costs and logistical probabilities of success. And third, we assume operatives are rational and can be one of two possible types: those who have "normal" opportunistic or self-interested

preferences and those who have some form of social preference. With respect to the latter type of operative, we assume that an operative with social preferences may either identify with some socially-defined standard, or is intrinsically motivated by the mission, its consequences, or association with the terrorist group and its stated goals. Our third assumption has the added benefit of encompassing most of the relevant literature which begins with the basic assumption of rationality but tends to view terrorists as possibly self-interested or motivated by various religious or social reasons. By allowing for either type of operative we not only recognize the problem faced by researchers in trying to test their hypotheses about what motivates suicide terrorists, but more importantly, we also recognize the problem faced by terrorist organizations themselves. In other words, if potential operatives have differing preferences with which it may be hard for a terrorist group to observe and distinguish between, then how a group should proceed and choose its tactics, its operatives, and divide its missions among the various operative types becomes less clear. One dilemma that a terrorist group faces is whether it should enlist only self-interested types for conventional attacks and socially-motivated individuals for suicide missions. Our results show that the answer to this question is that this can indeed be the case, and under certain conditions, it can be optimal for the terrorist organization to employ only one type of operative and undertake only one kind of mission. It may even be optimal to use both types for both kinds of operations.

Several papers are related to this study. Ferrero (2006) utilizes a two-period model and assumes that operatives have self-interested preferences. Operatives can join and enter contracts (agreements) with the terrorist organization in the first period with the expectation that, with some positive probability, they may be asked to undertake a martyrdom mission in the second period. Mission compliance can be ensured if sufficiently strong incentives exist that prevent

individuals from defecting and failing to fulfill their assignment. Like Ferrero (2006), we also utilize the notion of contracts, which specify a mission's degree of violence and likelihood of success (as a function of effort) but center our attention on a terrorist group's recruitment and tactic selection rather than on contract enforcement.

As Crenshaw (2007: 160) notes in her survey of twelve books on suicide terrorism, there is no longer the need to introduce an analysis of suicide attacks by explaining to the uninitiated that such tactics are not rooted in psychopathology on the part of the operative. She further adds that from the perspective of a terrorist organization's leadership, suicide is an adaptable and controllable tactic that has instrumental value for the organization. According to Iannaccone (2006), the most effective operatives are not those with nothing to live for, but those with something to die for. The most salient benefits include fame, honor, recognition, the perceived value of the suicidal act, rewards to family and friends, anticipated personal rewards in this life or next, and harm and humiliation imposed on enemies. In general, the stream of expected benefits starts well before the suicidal act and extends well beyond its conclusion. Socially constructed benefits weigh heavily in the actor's calculations, as do the subjective probabilities attached to the anticipated outcomes. In our paper, we therefore focus on the relationship between leadership and potential operatives, some of whom may be selected for suicide missions. In a related paper, Wintrobe (2006) models the interaction between leaders and followers and demonstrates how leaders can rationally employ extreme acts of violence as a result of the presence of indivisibilities that help create increasing returns for groups willing to employ such tactics. On the other hand, followers will tend to carry out such attacks if they ultimately identify with the leader's objectives and are willing to trade individual autonomy for group solidarity. Also relevant is McBride and Richardson (2012), who theoretically examine

the process by which leaders invest in indoctrination processes so as to foment social preferences within a subset of potential operatives. Our analysis begins at the point where leadership suspects that some operatives' preferences have been augmented by a concern for the group and must screen for operative types in order to effectively assign operatives to missions befitting their preferences.

Berman and Laitin (2004) is perhaps closest to our model in that the authors also look at the choice between suicide and conventional attacks. However they utilize a club model that provides benefits to those that choose to join and remain loyal to the group. Members will carry out suicide attacks if the payoffs of participation are greater than the payoffs from defecting. Operatives that are likely to defect are those with strong outside options as represented by an individual's wages that he or she can achieve in pursuing their next-best alternative. Thus, according to the authors, terrorist organizations will select operatives on the basis of wages and require costly sacrifices from potential members in order to protect themselves from defection. Our study differs in that we allow the terrorist group to offer separate contracts to different types of operatives and allow operatives to self-select and choose the appropriate mission designed for them by the terrorist group. The result is a novel characterization of organizational structure within terrorist groups.

Finally, our agency-theoretical approach explicitly recognizes both political/social considerations on the part of terrorist operatives as well as the economic context from which they are recruited. This is because our model captures both an operative's motivation and the opportunity cost of membership. Consequently, we provide a theoretical counterpart to the empirical literature on the tenuous relationship between terrorism and poverty (e.g., Krueger 2007). In particular, social motivation rather than poverty can explain terrorist operatives'

recruitment, the decision by leadership to use suicide terrorism, and mission success.³

2. The basic model

In this section we first specify the preferences of terrorist groups and their operatives and then characterize the interaction between the two as a principal-agent problem. Modern-day terrorism is conducted in a highly decentralized environment, characterized by operatives who are organized into cells and vary their tactics and financing arrangements in order to protect their organization's leadership. In this way, Shapiro (2007) discusses the unobserved actions of middlemen who transfer funds between leadership and operatives as an example of agency under moral hazard.⁴ Byman and Kreps (2010) consider the state-sponsorship of terrorism through the lens of moral hazard as well. By contrast, we are concerned with a terrorist organizations' selection of tactics – conventional versus suicide – and its ability to screen for the proper type of operative to carry out the mission. These are issues related to adverse selection (uncertainty about operatives (social) preferences) rather than moral hazard (uncertainty about operatives' actions).

Let S represent the payoff of a successful outcome of an attack planned by a terrorist organization's leadership (principals) and undertaken by their operatives (agents) whose level of effort is given by e_i , where the index i represents an agent's type. To further simplify, it is assumed that the action or effort of the agent translates into the probability that the attack is successful; therefore, $e_i \in [0,1]$. Thus let $S \in (0,1]$ represent the successful outcome with probability e_i , and let the outcome in the event of a failure take a value of zero, which occurs with probability $1 - e_i$. As in most characterizations of the principal-agent problem, the principal designs monetary incentives or their equivalent in an attempt to influence an agent's actions or to get the agent to reveal its type by selecting a specific contract. In this specific case, let f_i

represent the fixed payment offered by the principal and v_i be the variable payment that is contingent on the observation of a successful outcome. Note that the implied variable payment in the event of a failure is zero. The principal's payoff is therefore specified as:

$$\Pi_p = (1-r)(S-v_i)e_i - f_i$$

Where $r \in [0,1]$ is the principal's level of risk aversion.⁵ If $r = 0$ the principal is risk neutral and if $r = 1$ the principal is infinitely risk averse. Considering the nature of the uncertainty that inherently surrounds terrorist missions, the presumption of risk aversion seems warranted. For instance, a failed mission might allow the target to retrace the steps back to the organization's leadership while the benefits from a successful mission may be followed and moderated by several unfavorable repercussions. By contrast, the existence of risk-averse preferences for operatives, whether they are suicide operatives or not, is subject to debate and therefore each type of operative is assumed to be risk neutral. Note that risk aversion on the part of operatives is not necessary in order to produce an agency problem given leadership's incomplete information about the operative's type (social preferences).

We allow for three potential types of operatives. The first are operatives who derive their social identity from a standard for group behavior, e^* , as a result of their belonging to a group of operatives. These are known as α -types and have preferences represented by:

$$\Pi_\alpha = f_\alpha + v_\alpha e_\alpha - \frac{1}{2}e_\alpha^2 - \alpha(e^* - e_\alpha)$$

where the first two terms represent the monetary incentives provided to the operative by the leadership and the third term represents the operative's (quadratic) cost of effort. The fourth term represents the operative's social preferences. When $e^* > e_\alpha$ these preferences correspond to Akerlof and Kranton's (2008) social identity preferences. The term $\alpha > 0$ is the measure of the strength of social identity and e^* is the reference standard of effort established for this particular

grouping of operatives. Together, e^* and α are consistent with Neumayer and Plümer's (2009) conception of peer acknowledgement as a primary motivator of terror operatives since both form the basis upon which peer acceptance is founded upon. In keeping with our previous assumptions, $e^* \in [0,1]$.⁶ One of the more interesting characteristics of this specification of operative preferences holds when $e^* = 1$, corresponding to the desire that the mission be successful with certainty. In this case, the last term of the expression above can be interpreted as the loss in utility in the event of a failure: $\alpha(1 - e_\alpha)$.

Our second type of operative (and the second of the two types of operatives that are assumed to have social preferences), are intrinsically-motivated operatives (known as β -types):

$$\Pi_\beta = f_\beta + (v_\beta + \beta)e_\beta - \frac{1}{2}e_\beta^2,$$

where $\beta > 0$ is the additional intrinsic benefit the operative receives when the terrorist mission is a success. For example, β is the added benefit that an operative receives from succeeding in pursuit of a religious or social cause that the operative believes in, the ideological appeal of the cause, or the harm and humiliation imposed on the target subsequent to a successful attack. Alternatively, in the case of a suicide mission, it may represent the operative's perception of the benefit on martyrdom in the afterlife. More generally, β captures what the operative is willing to die for. This particular specification is related to motivated agents in the sense of Besley and Ghatak (2005); however, their contractual focus is quite different from ours.

Finally, we also assume that the terrorist group can recruit from conventional operatives who are opportunistic in the traditional sense of agency theory. Hereafter referred to as O -types, their preferences are assumed to take the following form:

$$\Pi_o = f_o + v_o e_o - \frac{1}{2}e_o^2.$$

Note that unlike the previous two types of operatives, this type lacks any additional incentives other than the monetary payments and the cost of effort.

Since we model a terrorist organization's choice between operative types and the missions they will be assigned to, it is useful to review the sequence of moves involving the two parties. In the first stage of the game, nature chooses the type of operative under conditions of incomplete information for the principal (adverse selection). In the second stage, the terrorist leadership proposes contracts (the missions) that operatives will ultimately be expected to carry out. Operatives can then accept or reject the proposed mission. Subsequently, the operative chooses effort, and if the suicide mission is successful, the operative ultimately perishes. A key insight is that suicide operatives cannot be motivated by monetary payments that are contingent on the outcome of the mission because they cannot, by definition, personally receive such a payment if the mission is a success. Operatives involved in conventional missions can receive such conditional rewards. Consequently, suicide missions must appeal to operatives either through their social preferences and/or the fixed component of the contract. In the final stage, the outcome is realized and payment is made for those accepting the conventional mission. It is assumed that the principal can credibly commit and enforce any contract proposed and accepted by an operative and there is no possibility for renegotiation.

Finally, note that the source of either motivation in terms of social preference could be a result of religious beliefs but need not be. Peer pressure, for example, may be an important factor in motivating suicide attackers as may be the case within the Palestinian community (Ricolfi, 2005). Also observe that the distinction between the two is unlikely to be settled via refutable hypotheses. Indeed, α -type preferences reduce to β -type preferences when $e^* = 0$; that is, when it is not the standard of effort itself that matters but only social pressure. Given this

possible ambiguity, we restrict our attention to the possibility that the terrorist group faces the conventional (opportunistic) type of operative and one of the two social-preference types of operatives but not both. We thus look at two scenarios, the first being the case where the group can choose between an operative with social identity, an α -type, and a conventional or O -type and the second, between an intrinsically-motivated β -type and a conventional type.⁷

3. Screening

To start, we assume that effort is verifiable and therefore known and enforceable by the principal but the principal cannot distinguish between operative types.⁸ Since the characteristics of each type are known along with the probability distribution for each, the principal can try and separate operative types by properly designing contracts tailored to appeal to a particular type while remaining unappealing to others. However, by definition, suicide operatives cannot personally receive a contingent (worldly) payment when their mission is successful. As such, we set $v_\alpha = v_\beta = 0$ when the principal is screening for operatives to undertake suicide missions, as operatives with social preferences are thought to be the more likely candidates for suicide missions. This does not imply that operatives with social preferences receive no contingent payoff; βe_β for example, remains an intrinsic expected payoff for β -types even when $v_\beta = 0$. One interpretation is that a suicide operative trusts (with weight β) that the terrorist organization will take care of his/her family in the event that the suicide operation is carried out and successful. Hence, the operative receives a contingent non-monetary benefit from this knowledge. At the same time, most terrorist organizations do not use suicide terror as their exclusive modus operandi. A successful attack of magnitude S can also be achieved by conventional (opportunistic) operatives who can receive conditional payments. For these operatives $f_O = 0$ and $v_O > 0$.⁹ Thus an α - or a β -

type receives a payment upon agreeing to supply effort for the mission while contracts for the O -type means that O -types receive payment after supplying effort once the outcome of the mission is known. Note that successful screening implies all operatives of a single type are treated the same and that different types are treated differently. Setting reservation utility for each type of operative to zero, for convenience, the participation constraints (PC) for each type are:

$$(PC_\alpha) \quad f_\alpha - \frac{1}{2}e_\alpha^2 - \alpha(e^* - e_\alpha) \geq 0$$

$$(PC_\beta) \quad f_\beta + \beta e_\beta - \frac{1}{2}e_\beta^2 \geq 0$$

$$(PC_O) \quad v_O e_O - \frac{1}{2}e_O^2 \geq 0.$$

For reasons stated in the previous section, we assume that the terrorist organization does not face α -types and β -types simultaneously. Consequently, when attempting an operation of a given size, we assume that the terrorist organization is either screening for α -types versus O -types or β -types versus O -types. We take each case in turn.

3.1. Screening for α - versus O -types

Let the screening contracts take the form (f_α, e_α) and (v_O, e_O) since these are the terms that the principal manipulates in order to induce operatives to reveal themselves by the choice of contract/mission that the principal has in mind for them. Operatives have incentives to reveal themselves if the characteristics of the mission satisfy the corresponding participation and self-selection (SS) constraints. The intuition of the SS constraints is that α -types prefer to reveal themselves (tell the truth) and go on a suicide mission versus lying and conducting a conventional operation (embodied in (SS_α)). Conversely, (SS_O) captures the idea that O -types prefer to tell the truth and engage in a conventional attack versus lying and becoming involved in

a suicide operation. The associated self-selection (truth-telling) constraints are:

$$(SS_\alpha) \quad f_\alpha - \frac{1}{2}e_\alpha^2 - \alpha(e^* - e_\alpha) \geq v_o e_o - \frac{1}{2}e_o^2 - \alpha(e^* - e_o)$$

$$(SS_o) \quad v_o e_o - \frac{1}{2}e_o^2 \geq f_\alpha - \frac{1}{2}e_\alpha^2.$$

Summing the two SS constraints and simplifying leads to the monotonicity condition, $e_\alpha \geq e_o$, which is intuitive for self-selection, as those under group pressure to adhere to the norm should exert more effort than opportunistic operatives.

We assume an interior solution such that $e^* > e_i > 0$, which clearly holds when $e^* = 1$, corresponding to the assumption that all attacks ultimately have some probability of failure. Consequently, the two SS constraints imply:

$$v_o e_o - \frac{1}{2}e_o^2 \geq f_\alpha - \frac{1}{2}e_\alpha^2 > f_\alpha - \frac{1}{2}e_\alpha^2 - \alpha(e^* - e_\alpha) \geq v_o e_o - \frac{1}{2}e_o^2 - \alpha(e^* - e_o).$$

From the above relations, we can easily see that if (PC_o) holds with equality then a contradiction results as the first term equals zero but the third term is either greater than or equal to zero by (PC_α) . Hence, (PC_o) cannot hold with equality in a screening contract.

Letting μ_α be the prior probability that the operative is a α -type (or the percentage of α -type operatives in the population that the terrorist organization recruits from), we can then state the principal's maximization problem as choosing the mission pairs (f_α, e_α) and (v_o, e_o) in order to maximize

$$E_p = \mu_\alpha [(1-r)S e_\alpha - f_\alpha] + (1-\mu_\alpha)(1-r)[(S-v_o)e_o]$$

subject to the remaining constraints:

$$f_\alpha - \frac{1}{2}e_\alpha^2 - \alpha(e^* - e_\alpha) \geq 0$$

$$f_\alpha - \frac{1}{2}e_\alpha^2 - \alpha(e^* - e_\alpha) \geq v_o e_o - \frac{1}{2}e_o^2 - \alpha(e^* - e_o)$$

$$v_O e_O - \frac{1}{2} e_O^2 \geq f_\alpha - \frac{1}{2} e_\alpha^2 .$$

In Appendix A we show that both (PC_α) and (SS_O) can be binding at the optimum.¹⁰ We also derive the following result.

Result 1. The levels of effort that maximize the principal's expected payoff when screening for α -type suicide operatives versus O -type conventional operatives are

$$e_\alpha = (1-r)S + \frac{[1 - (1 - \mu_\alpha)r]}{\mu_\alpha} \alpha \text{ and } e_O = S.$$

It can also be shown that $e_\alpha > e_O$, that O -types exert their first-best level of effort, and that the level of effort for α -types is greater than under complete information.¹¹

The intuition behind the above result is as follows. Recall that for screening contracts in adverse selection problems, it is quite common that one agent's action is first-best and the other's is distorted. As this is the case here, in order to screen for the two operatives and avoid giving too much utility (i.e., rent) to O -types (so as to keep them at first best), the principal distorts the effort level of the mission required for the α -type so as not to make that mission too attractive for O -types willing to pretend to be α -types.¹² Note that when the inequality between the two types of effort is strict, the principal is able to separate the two types of operatives.¹³

We can also perform simple comparative statics on the above expressions for effort. An increase in the value of a successful attack (S) results in increased efforts by both types of operatives. It can also be demonstrated that an increase in the measure of social identity (α) increases the effort of an α -type while an increase in the principal's measure of risk aversion (r) decreases it. The latter effect holds as a consequence of the principal's risk being tied to agent

preferences and its ability to screen for agent types. Since the principal is able to achieve a level of effort with respect to O -types that is first best, the principal does not want to distort the O -types' effort. However, reducing e_α reduces the added costs associated with increased risk aversion and as a result, reduces the randomness that the leadership experiences across both operative types.

In addition, we can see that an increase in the probability that the operative is an α -type reduces that operative's level of effort. This last result follows directly from the fact that as the probability of selecting the α -type increases, the less desirable it becomes for the principal to distort the α -type's mission in order to separate that type from the increasingly scarce O -type. Although this increases the rent of O -types, the fact that the O -type operative is less likely to be selected for the mission makes it less costly to give rent to the O -type as $\mu_\alpha \rightarrow 1$ and e_α approaches $e_\alpha = (1-r)S + \alpha$, the level of effort under complete information.

Using the above solution to the principal's optimization problem we can also derive the expressions for the incentive payments to be made to each type of operative from the binding constraints. Since these expressions do not offer further insights into the problem, we do not pursue this analysis any further.

However, because the O -type's contract is first-best it is relevant to inquire whether it is better for the principal to utilize only O -type operatives in conventional attacks rather than screening for both. Assuming that the self-selection constraint for the opportunistic type (SS_O) is the only one binding, other than (PC_α), it is possible to offer the O -type the first best or complete information contract, represented by the superscript "c" in the expression below.¹⁴ Evaluated at the optimum, selecting for only O -types is therefore strictly preferred to selecting both types when the principal's payoff from the former is strictly greater than the latter (where we note that $e_o^c = e_o$):¹⁵

$$(1-\mu_\alpha)(1-r)\left[Se_O^c - \frac{1}{2}e_O^{c2}\right] > \mu_\alpha\left[(1-r)Se_\alpha - \frac{1}{2}e_\alpha^2 - \alpha(e^* - e_\alpha)\right] \\ + (1-\mu_\alpha)(1-r)\left[Se_O^c - \frac{1}{2}e_O^{c2} - \alpha(e^* - e_\alpha)\right]$$

or

$$\alpha(1-\mu_\alpha)(1-r)(e^* - e_\alpha) > \mu_\alpha\left[(1-r)Se_\alpha - f_\alpha\right].$$

In other words, it is better to exclusively recruit *O*-types whenever the returns to doing so strictly exceed the expected payoffs of also recruiting α -types. At this point, the principal is better off selecting for only *O*-types and foregoing suicide missions. Since there is now no need to give added incentives to induce *O*-types to self-select for a conventional mission, the complete information and first-best contract can be implemented. Also observe that the above condition is more likely to hold the larger α and e^* are and the lower μ_α is. Note that the first two parameters reflect operative preferences in terms of their group identity. According to Kalyvas and Sanchez-Cuenca (2005), if the organization's base of support is more moderate, the terrorist organization will tend to forego suicide missions and conduct conventional attacks.¹⁶ According to the authors, one of reasons why the IRA chose not to undertake suicide missions was its fear of alienating its Catholic base and its supporters in the United States. The implication from our model is that under such conditions a terrorist organization will engage in conventional attacks and will avoid recruiting from a segment of operatives with preferences derived from a group different from the majority. Moreover, it will choose to utilize operatives that are less costly to motivate.

In this way, a novel contribution of our model is that it offers a theory as to why some terrorist groups never resorted to suicide missions, choosing instead conventional measures of attack. Our results are therefore complementary to Horowitz (2010) which also presents an institutional argument why certain groups (such as the IRA and ETA) do not adopt suicide attacks. According to the author's argument, such groups tend to have low organizational capital

while those that are most likely to adopt suicide attacks are those with high organizational capital.¹⁷ Groups with low organizational capital tend to be bureaucratic and tend to consist of members with a certain expertise, with strong vested interests, and views towards the strategy and tactics used by the organization. Although there may be other institutional and organizational obstacles that inhibit the use of suicide attacks, an additional factor or explanation may be one of supply, or quite possibly, of not being able to find the right operatives with the appropriate motivation. This is the issue to which we turn to next as we look at a different form of social motivation.

3.2 Screening for β - versus O -types

When operatives are motivated as a result of receiving an intrinsic reward from their efforts rather than through social identity, the interactions between the principal and the two possible operatives change. The source for this difference lies in the fact that when an operative is a β -type, the operative benefits from their successful effort but otherwise there is no loss of utility if those efforts fall short of a socially defined standard, as is the case when an operative is an α -type.

The terrorist organization in this scenario faces a screening problem involving the following self-selection constraints:

$$(SS_{\beta}) \quad f_{\beta} + \beta e_{\beta} - \frac{1}{2}e_{\beta}^2 \geq (v_O + \beta)e_O - \frac{1}{2}e_O^2$$

$$(SS_O) \quad v_O e_O - \frac{1}{2}e_O^2 \geq f_{\beta} - \frac{1}{2}e_{\beta}^2.$$

As before, adding up the self-selection constraints implies $e_{\beta} \geq e_O$. In other words, for successful self-selection, the same or greater effort is to be demanded from the operative that receives the added intrinsic benefit from their efforts than from the operative that does not.

Together these constraints also imply:

$$f_\beta + \beta e_\beta - \frac{1}{2}e_\beta^2 \geq (v_O + \beta)e_O - \frac{1}{2}e_O^2 > v_O e_O - \frac{1}{2}e_O^2 \geq f_\beta - \frac{1}{2}e_\beta^2.$$

In this case, (PC_β) , the above expression on the left, cannot bind as this would lead to a contradiction with respect to the third expression. Denoting μ_β as the prior that the operative is a β -type, the principal chooses the contract pairs (f_β, e_β) and (v_O, e_O) in order to maximize

$$E_P = \mu_\beta [(1-r)S e_\beta - f_\beta] + (1-\mu_\beta)(1-r)[(S-v_O)e_O]$$

subject to

$$v_O e_O - \frac{1}{2}e_O^2 \geq 0$$

$$v_O e_O - \frac{1}{2}e_O^2 \geq f_\beta - \frac{1}{2}e_\beta^2$$

$$f_\beta + \beta e_\beta - \frac{1}{2}e_\beta^2 \geq (v_O + \beta)e_O - \frac{1}{2}e_O^2.$$

Following similar arguments as before, as outlined in Appendix B, we obtain the following:

Result 2. The associated levels of effort that maximize the principal's expected payoff when screening for β -type suicide operatives versus O -type conventional operatives are:

$$e_\beta = (1-r)S + \beta \quad \text{and} \quad e_O = S - \frac{\mu_\beta}{(1-\mu_\beta)(1-r)}\beta$$

where β -types exert the level of effort consistent with complete information. If only the (SS_β) constraint binds, then $e_\beta > e_O$.

Unlike the previous screening problem between α -types and O -types, the O -type's effort is distorted downward, away from this operative's first-best level of effort (and the level of effort under complete information). When the O -type is paired with the β -type, the principal wants to avoid giving too much rent to the motivated types and so distorts the effort level required for the

O -type so as not to make that mission too attractive for β -types pretending to be O -types (see Appendix C).

As with the previous pairing of agent types, simple comparative statics can be performed on the above expressions. Thus an increase in the value of a successful attack (S) results in increased efforts by both types of operatives, while an increase in the measure of the principal's measure of risk aversion (r) reduces both e_β and e_O . We can also see that an increase in the operative's motivation (β) increases the level of effort for that type of operative but decreases effort for an O -type. That is, the spread between e_β and e_O is an increasing function of β . In addition, an increase in the probability that the operative is motivated has no effect on that operative's effort and decreases it for the O -type. In this case, as the proportion of β -types increases relative to that of O -types, the more desirable it is for the principal to distort the O -type's mission in order to separate the intrinsically-motivated types from the increasingly scarce O -type. This helps decrease the rent given to the β -type. Moreover, given the fact that the O -type operative is less likely to be selected for the mission than the β -type, the better off the principal is.

We also inquire whether it is better for the principal to utilize only the motivated operatives in suicide attacks rather than screening for both. In this case, only the self-selection constraint for the β -type binds. Following similar steps as before, selecting for β -types is strictly preferred to selecting both types whenever the principal's payoff from the former is strictly greater than the latter or when:

$$\begin{aligned} \mu_\beta \left[(1-r)S e_\beta^c + \beta e_\beta^c - \frac{1}{2} e_\beta^{c^2} \right] &> \mu_\beta \left[(1-r)S e_\beta^c + \beta e_\beta^c - \beta e_O - \frac{1}{2} e_\beta^{c^2} \right] \\ &+ (1-\mu_\beta)(1-r) \left[S e_O - \frac{1}{2} e_O^2 \right] \end{aligned}$$

or

$$\mu_{\beta}\beta e_o > (1 - \mu_{\beta})(1 - r)[Se_o - \frac{1}{2}e_o^2].$$

In this scenario, it is better to exclusively recruit motivated types whenever the associated returns strictly exceed the principal's expected payoff of also recruiting O -types. When operatives are likely to be β -types and have high internal incentives, the terrorist organization is better off if it does not try and screen for both types of operatives. Instead it should use β -types and only conduct suicide missions. One of the implications for terrorist organizations such as al-Qaeda, where the organization is able to use safe havens (e.g., Afghanistan, Pakistan or Somalia) and draw upon operatives that are strongly motivated by mission success, is that suicide missions will tend to be more attractive than conventional ones. Furthermore, the above inequality is more likely to hold with an increase in the principal's risk aversion ($r \rightarrow 1$). In such situations the principal would prefer to avoid contracting with both types of operatives so as to not be exposed to additional risks associated with a conventional attack.

Suicide attacks are also likely to be utilized when there is little risk in the attack alienating the population and the terrorist group's supporters. Kimhi and Even (2004) document the supporting factors for Palestinian suicide bombers in addition to personal motivating factors. For examples of the former, these include a sympathetic environment and a community that praises and commemorates the sacrifice along with a media that ensures wide coverage. More importantly for our purposes, the authors also identify several personal motives for enlisting in suicide attacks. Among the variety of motives, the desire for revenge, a religious, and a social or a nationalistic motive, are three major ones that are documented by the authors' study. A revenge motive for instance, may originate as result of a death of a family member, or as a result of detention or humiliation by Israeli occupation forces. Or one may simply be a witness to a traumatic or much publicized event (Kimhi and Even, 2004). In the context of our model, the

more significant and impressionable the event, the greater the grievance and the higher we would expect β to be. It is therefore not surprising that after just such incidents, as the supply of aggrieved parties potentially increases, affected individuals become the focus of a terrorist group's recruitment efforts (Saleh, 2009).

4. Conclusion

This paper investigates the phenomenon of suicide terrorism from the perspective of both the mission planner and operative who carries out the mission. Planners are rational and seek to inflict damage via conventional means or through the use of a suicide attack. In recognition of the discredited view that suicide operatives exhibit some form of psychopathology, operatives are instead viewed as rational; with some subset of the operatives possessing one of two types of social preferences. In planning a mission a terrorist group's leadership faces a screening problem of matching operative types to conventional or suicide missions. Our initial analysis is consistent with the fact that no terrorist organization employs suicide as its exclusive modus operandi.

We demonstrate that a terrorist organization is able to design incentives in order to separate operatives according to mission at a tradeoff that is measured in terms of the likelihood of the mission's success as a function of the operative's effort. In particular, operatives that are motivated by social identity (α -types) tend to be costly to incentivize relative to opportunistic operatives despite the additional motivation provided by the presence of social preferences. As long as the operative's probability of mission success falls short of the standard set by the operative's reference group, these preferences represent an added cost to the terrorist organization. No such cost exists for operatives that are intrinsically motivated by the mission's

success however, and the added (intrinsic) benefit the β -type operative receives from his or her effort ensures that such operatives are less costly to motivate than opportunistic ones. Moreover, suicide attacks will be preferred to conventional attacks when operatives with social preferences resemble β -types (rather than α -types) and terrorist organizations are comprised of or at least backed by similar types.

In addition, our examination of the relationship between leadership and operatives reveals why so little is understood about the economic roots of terrorism. In our analysis social motivation, rather than poverty, can explain suicide missions. Hence, neither psychopathology nor poverty is necessary to produce suicide operatives. What is of interest for future research however, is how indoctrination programs – whether religious or otherwise – can be used to foment social preferences among operatives and what policies can be used to neutralize these activities.

Appendices

A. Screening for α - versus O-types

Given that the (PC_O) constraint is strictly not binding, we can set up the principal's maximization problem using λ , θ , ψ as the associated multipliers for the remaining three constraints (respectively (PC_α) , (SS_O) , (SS_α)). The Lagrangian for this problem is given by:

$$L = \mu_\alpha \left[(1-r)S e_\alpha - f_\alpha \right] + (1-\mu_\alpha)(1-r) \left[(S - v_O) e_O \right] + \lambda \left[f_\alpha - \frac{1}{2} e_\alpha^2 - \alpha (e^* - e_\alpha) \right] \\ + \theta \left[v_O e_O - \frac{1}{2} e_O^2 - f_\alpha + \frac{1}{2} e_\alpha^2 \right] + \psi \left[f_\alpha - \frac{1}{2} e_\alpha^2 - \alpha (e^* - e_\alpha) - v_O e_O + \frac{1}{2} e_O^2 + \alpha (e^* - e_O) \right].$$

The first-order conditions with respect to the principal's decision variables are given by:

$$v_O: \quad -(1-\mu_\alpha)(1-r)e_O + \theta e_O - \psi e_O = 0$$

$$f_\alpha: \quad -\mu_\alpha + \lambda - \theta + \psi = 0$$

$$e_O: \quad (1-\mu_\alpha)(1-r)[S - v_O] + \theta[v_O - e_O] - \psi[v_O - e_O + \alpha] = 0$$

$$e_\alpha: \quad \mu_\alpha(1-r)S - \lambda[e_\alpha - \alpha] + \theta e_\alpha - \psi[e_\alpha - \alpha] = 0.$$

Using the first two conditions, we can solve for λ , which is given by $\lambda = 1 - r + r\mu_\alpha$. Given $r, \mu_\alpha \in (0, 1)$, this implies $\lambda > 0$. Thus (PC_α) is binding. We now solve for the case when, in addition to (PC_α) , both self-selection constraints bind and then later in this section we solve for the case when only (PC_α) and (SS_O) bind. Note first that $\theta > 0$. If it were equal to zero, then by the first condition above, $\psi < 0$, since $(1-\mu_\alpha)(1-r) - \psi = 0$. This contradicts the requirement that the multipliers be nonnegative.

Next we reduce the above four equations down to the following two:

$$(1-\mu_\alpha)(1-r)[S - e_O] - \psi\alpha = 0$$

$$\mu_\alpha \left[(1-r)S - e_\alpha \right] + \lambda\alpha + \psi\alpha = 0,$$

from which, after substituting in for λ , we obtain:

$$\mu_\alpha [(1-r)S - e_\alpha] + [1-r+r\mu_\alpha]\alpha + (1-\mu_\alpha)(1-r)[S - e_o] = 0.$$

Using the monotonicity condition from Section 3.1, $e_\alpha \geq e_o$, if the two self-selection constraints are binding, we have $e_\alpha = e_o = e$. After imposing this restriction in the equation above and combining terms, the equation reduces to:

$$(1-r)S + [1-r+r\mu_\alpha](\alpha - e) = 0.$$

Using the above expression we obtain the following expression when the terrorist organization is not able to separate between the two types of operatives:

$$e = \frac{(1-r)S}{(1-r+r\mu_\alpha)} + \alpha.$$

Using the above conditions we obtain the remaining two expressions for the multipliers:

$$\theta = \frac{(1-\mu_\alpha)(1-r)r\mu_\alpha S}{\alpha(1-r+r\mu_\alpha)}$$

$$\psi = \frac{(1-\mu_\alpha)(1-r)}{\alpha} \left[\frac{r\mu_\alpha S}{1-r+r\mu_\alpha} - \alpha \right].$$

From the above expression for ψ , we can see that the (SS_α) constraint will be binding whenever $r\mu_\alpha S / (1-r+r\mu_\alpha) > \alpha$. More importantly, whenever $r\mu_\alpha S / (1-r+r\mu_\alpha) < \alpha$, the multiplier is negative and thus the (SS_α) constraint cannot bind. From the monotonicity condition therefore, $e_\alpha > e_o$. Resolving the screening problem with the two binding constraints, (PC_α) and (SS_o) , we obtain the expressions for the effort levels given in Result 1 along with the following expressions for the associated multipliers (respectively) of the two binding constraints:

$$\lambda = 1-r+r\mu_\alpha$$

$$\theta = (1 - \mu_\alpha)(1 - r).$$

It can also be verified that the (SS_α) constraint strictly holds in this case.

Note that when the organization cannot separate the two types of agents we obtain the following results: $e < e_O = S$ and $e < e_\alpha = (1 - r)S + (1 - r + r\mu_\alpha)\alpha / \mu_\alpha$. That is with the additional binding constraint, effort levels of both the O -type and the α -type are distorted down and away from their associated levels under the two binding constraint case.¹⁸

B. Screening for β - versus O -types

Following similar procedures as above, we can set up the principal's problem as in Appendix A with the following multipliers, λ , θ , ψ , associated with the remaining constraints (PC_O) , (SS_β) , and (SS_O) respectively. As before we get similar first-order conditions for the variables v_O , f_β , e_O , and e_β , from which we obtain the following expressions after assuming that both self-selections constraints bind:

$$e_\beta = e_O = e = \frac{(1 - r)S}{(1 - r + r\mu_\beta)}$$

$$\lambda = 1 - r + r\mu_\beta$$

$$\theta = \frac{r\mu_\beta(1 - r)(1 - \mu_\beta)S}{\beta(1 - r + r\mu_\beta)}$$

$$\psi = \mu_\beta \left[\frac{r(1 - r)(1 - \mu_\beta)S - \beta(1 - r + r\mu_\beta)}{\beta(1 - r + r\mu_\beta)} \right].$$

From the last expression we can see that whenever

$$\frac{r(1-r)(1-\mu_\beta)S}{(1-r+r\mu_\beta)} < \beta,$$

or when $e_\beta > e_o$, the O -type's self-selection constraint cannot be binding since $\psi < 0$.

However a pooling contract remains possible whenever (SS_o) is binding, i.e., when $\psi > 0$ or $\beta > r(1-r)(1-\mu_\beta)S / (1-r+r\mu_\beta)$. In this case, the principal does not distinguish between operative types and requires that each type exert the same level of effort and receive the following incentive payments: $f = ve = \frac{1}{2} \left[(1-r)S / (1-r+r\mu_\beta) \right]^2$. Note that the incentive payments are at the same level but each type of operative must receive their payment at a different point in time. Since there is no preference with respect to the timing of payments, no renegotiation, and since both self-selection constraints are binding, operatives are indifferent between choosing which of the two types of missions to accept.

C. The Complete Information Contract and Asymmetric Information

In this section, we determine whether or not the terms of the complete information contract can be implemented under asymmetric information. We check this for the case when the principal attempts to screen between β - and O -types. In this case, the β -type has an incentive to prefer the O -type's complete information contract. In order to demonstrate this, we first define and derive the optimal contract under complete information when the operative is socially motivated. Under these conditions the terrorist organization's problem can be stated as choosing f_β and e_β in order to maximize $(1-r)Se_\beta - f_\beta$ subject to $f_\beta + \beta e_\beta - \frac{1}{2}e_\beta^2 \geq 0$. It is readily apparent that the principal wants f_β as small as possible and therefore the operative's participation constraint is binding. Solving for the fixed fee and substituting the expression into

the objective function and then optimizing with respect to effort, we obtain the following result:

$$e_{\beta}^c = (1-r)S + \beta. \text{ }^{19}$$

Under complete information, the motivated or the β -type operative receives:

$$f_{\beta}^c + \beta e_{\beta}^c - \frac{1}{2}e_{\beta}^{c2} = 0. \text{ If the } \beta\text{-type selects the } O\text{-type contract, the } \beta\text{-type obtains}$$

$$(v_o^c + \beta)e_o^c - \frac{1}{2}e_o^{c2}. \text{ Since the } O\text{-type's participation constraint is binding under complete}$$

information conditions, we have $v_o^c e_o^c - \frac{1}{2}e_o^{c2} = 0$. Thus the motivated type gets a payoff of

$\beta e_o^c > 0$ if it accepts the conventional mission.

Notes

¹ Berman (2009) also discusses suicide terrorism but ignores the question of motivating suicide operatives (which is the subject of the present paper). The authors would like to thank an anonymous referee for pointing this out.

² For an example of the psychological approach, see Elster (2005).

³ Although not strictly tied to explaining suicide missions, Bueno de Mesquita (2005) can also be read as an attempt to reconcile contradictory empirical findings about the relationship of poverty (or wages) and terrorism.

⁴ A more formal model of the moral hazard problem described here is given in Shapiro and Siegel (2007). See also Gates (2002) for the related issue of moral hazard in rebel organizations.

⁵ This summary measure of risk aversion was introduced by Dow (2004) and more recently by Carlin and Gervais (2009).

⁶ Note that we preclude the possibility that $e^* < e_\alpha$, which may occur if the reference standard is low enough. Although this may be considered a case of overachievement, this setting tends to eliminate the incentive problem (given costly effort) and make social preferences more like that described by the second type of social preferences that we investigate (which we refer to as type β). Nonetheless, if we allow the standard to be endogenous to the model, something that we leave for future research, it would be useful to allow for this possibility.

⁷ Having the organization screen for the three types of agents becomes more cumbersome and technically demanding without guaranteeing further insight into the phenomena under study. Nevertheless, the present paper may be considered the first step to addressing a much more complex scenario.

⁸ With respect to verifiability of effort, in as much terrorist attacks, conventional or suicide, are

planned; there is a strong relationship between effort, execution, and outcome. Thus, whether or not effort falls short of required effort, that fact is likely to be known upon the failure or success of the mission. Moreover, shirking or the failure to live up to expectations can be credibly punished by carrying out possible prior threats, implied or otherwise, made, as the case may be, to the agent and the agent's family.

⁹ Since a payment to the agent can consist of a fixed rate and a variable rate, the assumption $f_o = 0$ is not necessary. Our assumption is thus a simplification for motivating risk neutral O -type operatives.

¹⁰ We can also follow Cooper's (1984) characterization that a screening contract is pairwise characterized by a binding PC for one type and a binding SS for the other type, and thus the screening contract – if feasible – can be derived by assuming that (PC_α) and (SS_o) are binding and later verifying that at the optimum (SS_α) strictly holds.

¹¹ With respect to e_o , the level of effort to be exerted by an O -type agent is equal to its first-best level irrespective of whether the situation is characterized by complete or asymmetric information. Also observe from the above solution that this holds whether the principal is risk neutral ($r = 0$) or not ($1 > r > 0$).

¹² By rent, we mean the extra payoff an agent may receive over and above his next best alternative, which has been normalized to zero for all agents.

¹³ In Appendix A, we also characterize the outcome when the principal is not able to differentiate between the two types and offers contracts such that the effort level is the same for both.

¹⁴ For a characterization of the O -type contract under complete information, see Appendix C.

¹⁵ The right-hand side of the first inequality is pre-multiplied by $(1 - \mu_\alpha)$ because only O -types will accept (v_o^c, e_o^c) .

¹⁶ Note that a small μ_α just reinforces this from the point of view of the terrorist group. When the probability of selecting an α -type is small, the operative's preferences are less likely to be mirrored by similar preferences in the supporting population.

¹⁷ In Horowitz's framework, organizational capital or capacity can be evaluated by a group's organizational age. Thus terrorist groups with low organizational capital will likely consist of older groups, i.e., those with higher organizational ages. See Horowitz for a more detailed argument and Olson (1982) for a related one.

¹⁸ The authors would like to thank an anonymous referee for pointing this result out.

¹⁹ The principal's problem when the agent is the O -type is given as: Maximize $(1 - r)(S - v_o)e_o$ subject to the participation constraint, $v_o e_o - (1/2)e_o^2 \geq 0$.

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