

costs for the aggressor will exceed any possible gains.⁶ Deterrence theory (in the broadest meaning of the term, also including non-nuclear deterrence and extended deterrence) has been tested on many different occasions, from very different angles, and with contradictory outcomes.

The debate between Huth and Russett on the one hand and Lebow and Stein on the other, in particular, became the focus of much attention among deterrence theorists. Huth and Russett found that extended deterrence was successful in about 60 percent of the 67 cases that they investigated.⁷ Lebow and Stein attacked the findings of Huth and Russett, which sparked a debate on the effectiveness of deterrence.⁸ The debate is still ongoing and has not yet led to unambiguous answers on whether deterrence works, and if so, under what circumstances.⁹ What is clear at least is that Wohlzetter's remark in 1999, that deterrence is 'neither assumed nor impossible', is still valid.¹⁰ Among theorists of the neorealist school of international relations as well as in most foreign policy circles, there is still a widespread belief in the effectiveness of deterrence. These beliefs are aptly summarised by the neorealist thinker Kenneth Waltz who claims that 'nuclear weapons are in fact a tremendous force for peace and afford nations that possess them the possibility of security at reasonable cost.'¹¹ This position led Waltz to advise policy makers to allow Iran to have nuclear weapons as it would restore stability in the Middle East.¹² However, the assurance with which claims like these are made ignores that 'deterrence (...) is not automatic'¹³ and underestimates the uncertainties and contingencies that influence the effectiveness of deterrence.

Since deterrence is a policy that maintains the nuclear threat rather than reducing it, an

alternative approach is needed. This is where nuclear arms control comes in. Nuclear arms control is strongly connected to deterrence theory. Schelling and Halperin defined arms control as a foreign policy instrument to limit the arms race between opposing states. According to the authors, arms control is aimed at (i) 'the avoidance of a war that neither side wants,' (ii) 'minimizing the costs and risks of the arms competition,' and (iii) 'curtailing the scope and violence of war in the event it occurs.'¹⁴ This conceptualisation makes nuclear arms control part of nuclear strategy in which deterrence plays a key role, but in which there can also be a place for what can be called functional disarmament (as opposed to general and complete disarmament). Deterrence is central to arms control and arms control without deterrence is unthinkable.¹⁵ This becomes very clear not only from the writings of early thinkers about arms control, such as Schelling and Halperin, and Bull,¹⁶ but also in the position of the four former US politicians who gave the call for worldwide abolishing of nuclear weapons in January 2007 in the *Huff Street Journal*: George Schultz, Henry Kissinger, Sam Nunn and William Perry (rebranded the 'Four Horsemen of the Nuclear Apocalypse') have always emphasised the importance of keeping a 'credible deterrent' while working towards global zero.¹⁷

Where arms control differs from mere deterrence is in its inclusion of functional disarmament. Functional disarmament is disarmament that serves the objectives of arms control. The Strategic Arms Reduction Talks (START) I and II are examples of arms control treaties that include agreements on disarmament. Disarmament in START I and START II (which never entered into force) was functional, because it was designed to help maintain a nuclear balance between the US and the Soviet Union.

BILATERALISM AND NUCLEAR SECURITY

Dr. Henk PELLIGAN AND Dr. Niels VAN WILLIGEN

The nuclear threat is a security dilemma in international politics,¹ and cooperation under a security dilemma is not just an academic or theoretical problem. It is foremost a policy problem that needs to be solved by foreign policy decision makers. However, to come up with a policy that increases nuclear security – which is to say, reduces nuclear arms – it is necessary to take a closer look at the dilemma. Following the work of Mancur Olson,² global nuclear security is best seen as a global public good in which states have an incentive to behave as free-riders. Refraining from any voluntary contribution to nuclear disarmament does not necessarily spring from self-regarding motives. It could be the result of a rational calculation that the policy of an individual state has no significant effect on the global nuclear threat.

This paper argues that it is highly unlikely that global nuclear security will ultimately be achieved through multilateral disarmament. It maintains that the global nuclear threat is best tackled through strategic dyads. It is much more likely that states will opt for nuclear disarmament in a bilateral setting than in a multilateral setting.

In a bilateral setting, it is not possible to behave as a free-rider. The states involved are so interdependent that pursuing an abstract global public good, but not addressing immediate national and bilateral security concerns. This paper elaborates on this argument by drawing on theoretical insights from game theory and by referring to the bilaterally driven nuclear disarmament process since the end of the Cold War.

Deterrence, Arms Control and Disarmament

Since the dawn of the nuclear age, deterrence has been a key component of strategic thinking. Political leaders from all over the world believe that deterrence is an effective strategy for protecting national security. A policy of 'peace through strength' led to a unilateral build-up of armaments and therefore to a mutual arms race during the Cold War.³ The belief in deterrence also prevented the total elimination of nuclear weapons after the Cold War ended. Deterrence assumes that decisions are made in accordance with a rational cost-benefit calculus and that the

Since national security (and not disarmament) is the primary objective of arms control, it could even involve the increase of arms if that leads to a better balance.⁸

Thus, functional disarmament stands in contrast to the third approach to the nuclear threat, which is general and complete nuclear disarmament. Next to the initiative of the 'Four Horsemen,' this approach is amongst others reflected in the Baruch Plan of 1946, US President Reagan's call for a world free of nuclear weapons in the 1980s, the 1996 report of the Canberra Commission on the Elimination of Nuclear Weapons,⁹ US President's Obama's call for 'Global Zero' (see below) and the recently formed International Campaign to Abolish Nuclear Weapons (ICAN).¹⁰ General and complete disarmament has a utopian connotation, because it assumes that states will rationally decide to eliminate a category of arms that clearly have strategic benefits. To different degrees, general and complete disarmament was successful with certain categories of weapons, including chemical weapons, biological weapons, anti-personnel landmines and cluster munitions. However, nuclear weapons form a different category. Not only because they provide strategic deterrence, but also because they bring prestige and influence to states that have them. That makes the general and complete disarmament approach hard to realise. The conclusion of the Treaty on the Prohibition of Nuclear Weapons (TPNW) in July 2017 is an important step forward in stigmatising the possession of nuclear weapons. However, its direct effect on the actual number of nuclear weapons in the world was limited, since the nuclear weapons states and their allies decided not to participate.

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findings on the effectiveness of deterrence and the utopian nature of general and complete disarmament, arms control is arguably the best approach towards increasing nuclear security. Arms control is based on (bounded) rational decision-making and risk analysis of possible future scenarios linked to national security. The arms control approach is consequentialist – i.e. based on utilitarianism – and it includes the logical possibilities of two extreme outcomes, namely nuclear security in case of success, and nuclear destruction in case of failure. Historically, the reduction of nuclear weapons was the result of bilateral initiatives between the US and the Soviet Union/Russia. The already mentioned START I and START II were preceded by the Strategic Arms Limitations Talks (SALT) in the 1970s and followed by the Strategic Offensive Reduction Treaty (SORT) in 2002. Also, the Intermediate-Range Nuclear Forces (INF) treaty was a bilateral agreement (and exceptionally also an example of general and complete disarmament, since it abolished an entire category of nuclear weapons). All these bilateral agreements were focused on American and Soviet/Russian national security considerations in the first place. That the

agreements also contributed to global nuclear security was a (very positive) side effect.

It is different with the two multilateral agreements, which include general and complete disarmament provisions, namely the nuclear Non-Proliferation Treaty (NPT, 1968) (that includes Article 6 as the general and complete disarmament provision) and the TPNW (2017). These multilateral treaties aim for increasing global nuclear security through general and complete nuclear disarmament as a global public good (although it should be noted that this is much more the case with the TPNW than with the NPT). In the next sections, we use game theory to show why adopting a multilateral global public good approach is less effective than pursuing a bilateral national security approach.

The Problem of Nuclear Security as a Global Public Good

Following the call of the 'Four Horsemen,' former US president Barack Obama launched the ambitious goal for a nuclear-free world in April 5, 2009, in Prague, which became known as 'Global Zero.' This policy was a long-term strategy to abandon nuclear weapons and Obama was well aware that there was no easy fix. Like the TPNW, Global Zero represented an attempt at general and complete nuclear disarmament. This approach sees global nuclear security as a global public good. However, Olson¹¹ identified that a global public good is difficult to realise. If we assume that even if there is only one unwilling state, which does not share the common interest of global nuclear security, then the likelihood of attaining global nuclear security is very low. This is what US ambassador to the United Nations, Nikki Haley, referred to when she rhetorically asked whether anyone believes that North Korea

would agree to support a global ban on nuclear weapons.¹²

On the other hand, even if we assume that there is no unwilling state and that all states share the common interest of global nuclear security, multilateral complete and general disarmament is not the logical outcome. Since global nuclear security is a global public good, it follows that rational and self-interested nuclear weapons states will not make voluntary contributions to realise it.¹³ Even in an alliance of like-minded countries, such as NATO, the logic of collective action produces free-riding behaviour. Several studies confirm the thesis of Olson and Zeckhauser¹⁴ that a large ally like the US shoulders the defence burden of smaller allies in an alliance.¹⁵ It illustrates how widespread the problem of collective action is, which is explained by the observation that "it is commonly observed that small groups seem better able to cooperate amongst themselves than do large groups."¹⁶

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Olson's logic of collective action rules out a unilateral, voluntary contribution to general and complete disarmament by nuclear weapons states, even if all states were to benefit from it. Instead, it is more likely that free-riding and cheating will occur. Olson's argument is

supported by game theory, which shows that multilateral approaches are impaired by non-cooperative behaviour. We use the theoretical insights from the Chicken Game to illustrate this. The term 'Chicken Game' was coined by Bertrand Russell who compared the Cold War nuclear brinkmanship of US Secretary of State John Foster Dulles with a game of 'Chicken'. 'Since the nuclear stalemate became apparent, the governments of East and West have adopted the policy which Mr. Dulles calls 'brinkmanship'. This is a policy adapted from a sport which, I am told, is practised by some youthful degenerates. This sport is called 'Chicken':¹

The original game as described by Russell has two players, each of whom has two strategies to avoid a collision (between car drivers, for example): Swove (C) or Drive Straight (D). Figure 1 illustrates the Chicken Game in which the highest preference of each player is to be the winner (4) and the lowest preference is a frontal collision of the cars (1). The second preferred outcome is that both players swerve to avoid a crash (3) and the third preference is to be the 'Chicken' which indicates the car driver who decides to swerve whereas the other car driver decides to drive straight (2). The preference ordering of each player is therefore $4 > 3 > 2 > 1$. The distribution of the payoffs of the players

leads to the payoff matrix shown in Figure 1.

Russell uses the metaphor of the Chicken Game to discredit political leaders who behave like irresponsible boys in the nuclear stand-off. This is not necessarily the case in all strategic interactions. In Game Theory, the Nash equilibrium – conceptualised by the mathematician John Forbes Nash – is a stable state reached between players, but where no player has an incentive to change the strategy that has led him to the equilibrium. But there are two Nash equilibria in the above matrix: outcome (4, 2) and outcome (2, 4). If the game had only one equilibrium, each player would have chosen the strategy that leads to it. The problem with the Chicken Game is that there are two equilibria, and each equilibrium is on the path of one of the two strategies. If each player wants to realise the equilibrium with his highest payoff, then player 1 will play strategy (D)(Defect) and player 2 will play strategy D as well and the result will be a frontal collision (1, 1). Both players end up with the worst possible outcome if each player aims at his personal best Nash equilibrium. This means that realising a Nash equilibrium is no longer a useful maximising rule for making a rational choice when there are multiple equilibria.

One way to avoid the negative outcome of the Chicken Game is by using so-called 'mixed

Figure 1: Chicken Game

		player 2	
		C swerve	D drive straight
player 1	C swerve	3, 3	2, 4
	D drive straight	4, 2	1, 1

strategies' to realise a mixed strategy Nash equilibrium. In this case, each player randomises his strategy to avoid the frontal collision of the Chicken Game. When players randomise their strategies, they are indifferent between the strategies and transform the Chicken Game into the Matching Pennies game.² The solution to the Matching Pennies game is that each player should choose a probability of 0.5 for each strategy (because the players are indifferent between their strategies). So, the notion of mixed strategies is like distributing for each outcome a lottery ticket with 25 percent chance of becoming the actual outcome of the game. This solution of a mixed equilibrium should be rejected, because responsible political institutions and leaders will ignore the option if the game represents a conflict situation that involves nuclear weapons. One could extend Einstein's expression 'Gott würfelt nicht' ('God does not play dice')³ by stating that political leaders of a nation do not play dice when it comes to using nuclear weapons.

Once the Nash equilibrium and the mixed strategy Nash equilibrium are no longer guidelines for maximising utility, there is only one rational solution left: the 'maximin strategy.'

The maximin strategy for each player is the strategy that avoids the worst possible outcome for that player.⁴ The maximin strategy is aimed at maximising one's minimum gain and leads to the status quo that existed during the Cold War (3, 3) as the solution of the game. During the Cold War, the two major powers cooperated in spite of their differences to avoid nuclear war. However, if one increases the number of players from two to three or even more, and thus switches from a bilateral to a multilateral setting, the game changes fundamentally. We explain the dynamics of the multilateral setting by discussing a three-person Chicken Game as represented by the cubes in Figures 2 and 3.

In the three-person Chicken Game, the positions of Players 1 and 2 remain the same and Player 3 makes a choice between Strategy C (cooperate) on the front of the cube and Strategy D (defect) at the back of the cube. The payoffs of the three players are presented in the three-dimensional cube and the distribution of the payoffs of the players in the cube in Figure 3 is based on the same rules as in Figure 1. In the rows, the payoffs of player 1 are presented first, the payoffs of player 2 second and the payoffs of

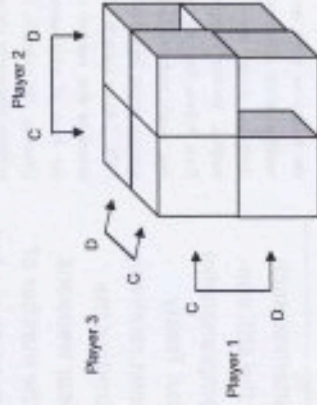
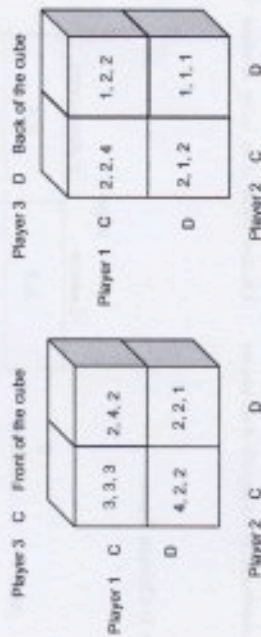


Figure 2: A three-dimensional three-person game: the cube

Figure 3: The three-person Chicken Game



player 3, third. The three-person Chicken Game does not have mutual cooperation as a solution. Each player in the three-person Chicken Game has a weak dominant strategy. Defect and the outcome of the game is mutual defection, the cell at the back of the cube at the bottom right cell (1, 1, 1).

This game is a simple example showing that the best move of a player changes if the setting changes from a two-person situation to a three-person situation. If we add more players, the strategy Defect will become a strong dominant strategy. The game illustrates that the best move in a security dilemma depends on the number of players. The setting of a two-person Chicken Game represents a situation of a bilateral kind, while the three-person game shows what will happen in a multilateral situation. The potential willingness to cooperate will decrease when the number of players (states) increases.

Bilateral and Multilateral Nuclear Security

In the former section, we represented a game-theory argument showing that in a bilateral

Multilateral initiatives such as the NPT, or the still non-operational Comprehensive Nuclear Test Ban Treaty (CTBT), have been relatively successful in limiting the spread of nuclear weapons and reducing the number of nuclear tests respectively, but they have not contributed to nuclear disarmament.

the incentives were less advantageous. Since multilateralism offers one general deal for all, there are always states that have a member surplus. Verdier mentions Mexico, Ecuador, Peru, Bolivia, Senegal, and Morocco as countries that "would probably have given up the nuclear-weapon option for much less than offered by the NPT."¹¹ At the same time, the NPT also includes countries that needed extra compensation in the form of multilateral security guarantees (Norway, for example, by NATO) or bilateral security guarantees (Japan, for example, in the form of an alliance with the US) before they would support the NPT.¹² Member surplus is not an issue in bilateral agreements, because it is inherent to the bilateral process that two states can tailor the agreement.

The choice for multilateralism or bilateralism is determined by the levels of transaction costs and member surplus. The higher the transaction costs and the lower the member surplus, the more attractive multilateralism becomes. The opposite is also true: the lower the transaction costs and the higher the member surplus in case a multilateral approach would be chosen, the more attractive bilateralism is. The nuclear non-proliferation regime is illustrative of the third possible outcome in which transaction costs and member surplus are both high and in which bilateralism and multilateralism both occur.¹³ Verdier argues that the "inefficiency of multilateralism" is a cause for bilateralism.¹⁴ It explains, for example, why bilateral security guarantees were made to non-nuclear weapons states in addition to the NPT. This argument can be taken one step further by pointing to the regularly occurring practice of bilaterally prospering and implementing multilateral agreements. The costs of the NPT, for example, lie in an informal bilateral agreement between the USSR and the US in 1966. At the time,

principles of conduct' producing 'diffuse reciprocity.'¹⁵

The dichotomy between bilateralism and multilateralism is a false one. Thompson and Verdier¹⁶ have convincingly shown that in many instances both bilateralism and multilateralism are needed to have a strong international regime. They point out that multilateralism also has its inefficiencies, which in the end cause states to opt for bilateralism in addition to the multilateral agreement(s) that they have concluded. While the clear advantage of multilateralism lies in lowering transaction costs, its disadvantage is that it creates member surplus. Thompson and Verdier explain member surplus as the difference between the multilaterally agreed upon incentives provided by the treaty and the individual incentives of the participating states. Because the scope of the incentives of a multilateral treaty is determined by the state that has the highest compliance costs and thus is least willing to participate, there are always individual states that would have signed the treaty even if

only these two major powers were involved, and the UN's Committee of Disarmament was excluded.¹⁹ Thus the origins of the multilateral NPT include bilateral elements. It shows that bilateral agreements can be a necessary first step to creating multilateral agreements.

Conclusion

Strategic dyads, bilateralism, functional disarmament and arms control are all important for progress towards nuclear security. However, that does not mean that the multilateral approach should be abandoned. Multilateral structures provide the context within which bilateral negotiations take place. The norms and principles of the nuclear non-proliferation regime are important guidelines for bilateral initiatives. New informal initiatives such as the Non-Proliferation and Disarmament Initiative (NPDI), which among other objectives, aims to strengthen the IAEA safeguards system and increase transparency in nuclear disarmament, are crucial for keeping up diplomatic pressure on nuclear weapons states. However, it is very unlikely that multilateral agreements will sufficiently contribute to nuclear disarmament. In spite of the existing multilateral agreements and the recent adoption of the TNPW, the pace of nuclear disarmament has slowed down, relations between the US and Russia as the largest nuclear powers have deteriorated, India and Pakistan have intensified their strategic nuclear arms race, North Korea's nuclear tests and ballistic missile programmes is high on the international agenda

When nuclear security is approached as a global public good, problems associated with collective action, such as free-riding, occur. The Game of Chicken illustrates that even when only one additional state is added to the bilateral setting, achieving nuclear security becomes much more problematic.

and nuclear weapons states are modernising their arsenals. Within this context, disarmament is more likely to succeed within a bilateral context of strategic nuclear rivalry rather than within the multilateral context of general and complete disarmament initiatives such as the TNPW. When nuclear security is approached as a global public good, problems associated with collective action, such as free-riding, occur. The Game of Chicken illustrates that even when only one additional state is added to the bilateral setting, achieving nuclear security becomes much more problematic. There is no guarantee that an arms control policy, based on strategic dyads, will work, but it is a more realistic option, as evidenced from the game theory argument and historical empirical evidence.

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