THE IMPACT OF EMERGING TECHNOLOGIES ON ARMS CONTROL REGIMES
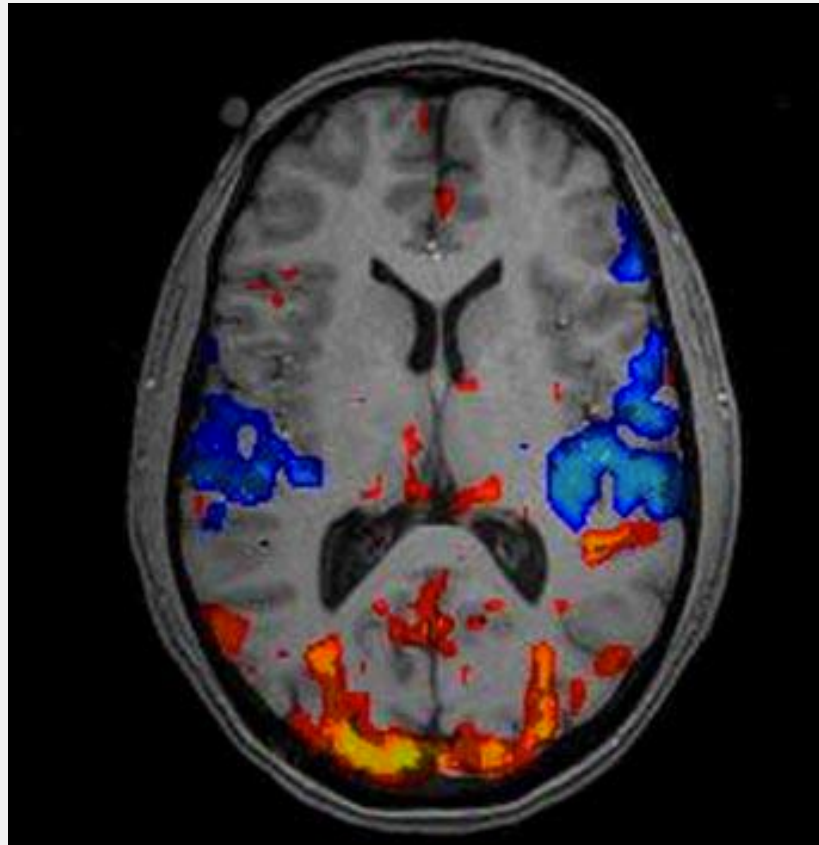
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FMRI IMAGE OF HUMAN BRAIN

CONVENTIONAL FORCES IN EUROPE TREATY (1989)

ARMS CONTROL AGREEMENTS

A security tool of either constraint or restraint, designed to be used in concert with other security tools, often in the service of crisis prevention.

ARMS CONTROL & WEAPONS REGIMES

Serve the purpose of:

- Regulating, reducing or eliminating weapons and sensitive technologies,

- Curbing the destructive potential of warfare,

- Eliminating unacceptable forms of warfare,

- Lowering the likelihood of use by "illegitimate" owners.

WEAPONS SUBJECT TO LIMITATIONS

- Nuclear Weapons

- Conventional Weapons

- Biological, Chemical and Radiological weapons

HOW SHOULD NEGOTIATORS COME TO THE TABLE?
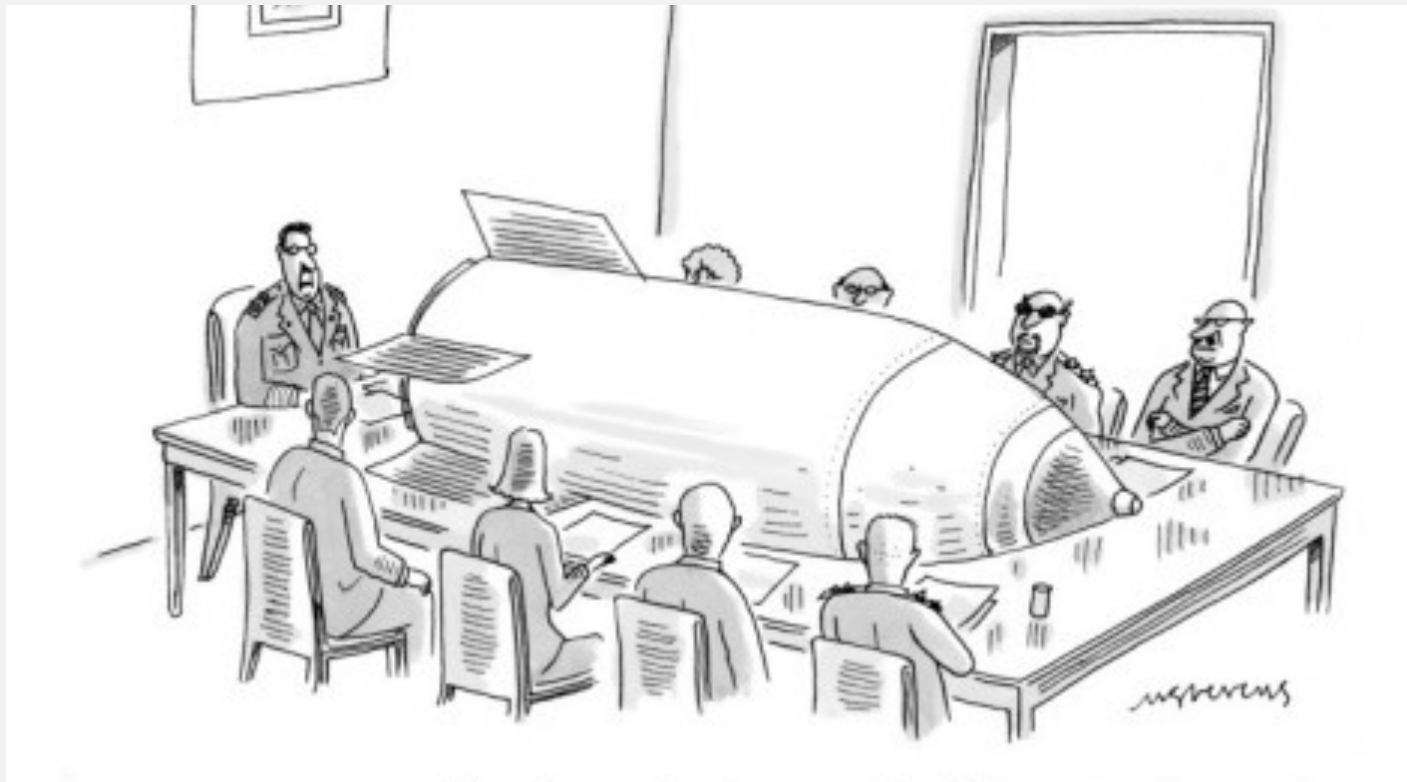
"As you know, all options are on the table."

COMPREHENSIVE ARMS CONTROL DATASET

- 42 bilateral and multilateral negotiations (1945-2010)

- 43 resulting agreements

- Nuclear, conventional, chemical and biological weapons.

- CSBM only agreements

- Binding and non-binding agreements

ESTABLISHING GOALS UNDER UNCERTAINTY

Negotiators use of **security-specific heuristics** to anticipate the outcomes of a potential conflict.

- **Worst-case scenario thinking**

- **Limited theater of war** thinking (one-weapon type planning)

- **Low-dimension** (non-complex) scenario thinking

STRATEGIES FOR ACHIEVING GOALS UNDER UNCERTAINTY

Negotiators often rely on **risk reduction strategies** to **lower likelihood of potential loss**.

- Setting **thresholds** for weapons

- **Eliminating** whole categories of weapons

- Establishing **verification** regimes to reduce risk of defection

- **Limiting scope, scale, duration** of agreements

RISK REDUCTION AND UNCERTAINTY MANAGEMENT

RR

Risk reduction: Pursuit of goals designed to minimize loss.

UM

Uncertainty management: Pursuit of goals designed to establish or maintain flexibility to respond to changing or dynamic world.

Defense Distributed: The Liberator (2013)

NEW CHALLENGES: ARMS CONTROL AND EMERGING TECHNOLOGIES

- Nuclear regimes: treaty and norm violations

- Conventional regimes and controls: increasingly porous

MULTILATERAL EXPORT CONTROL REGIMES

Preventative mechanisms for spread of weapons technology and information. Obstacle to acquisition and use by illegitimate users.

1. Wassenaar Arrangement (1996)
2. Nuclear Suppliers Group (NSG) (1974)
3. Australia Group (1985)
4. Missile Technology Control Regime (MTCR) (1987)

DOMESTIC EXPORT CONTROLS

- Multilateral export control regimes require domestic implementation by state parties.

- Voluntary, not legally binding.

- Regulate the shipment or transfer, by whatever means, of controlled items, software, technology, or services

- U.S.: "Exports" regulated by International Traffic in Arms Regulations (ITAR); statute (legal basis) is Arms Export Control Act (AECA).

WHAT'S NEW?

1. Increased Rate of Production of Novel Technologies (Military and Civilian)

2. Digitization

3. Effects of Diffusion and Contributions to Latency

1. INCREASED RATE OF PRODUCTION

- Augmented drive to produce new military and digital technologies (technology pull).

- Boom in organic private sector innovation with dual-use applications (technology push).

- New and old models of innovation on rise: both push and pull.

- Global rise in procurement demand.

2. DIGITIZATION

- Expansion of domain of warfare to cyber and electronic

- Digital rendering of existing weapons and weapons-related information

- Predilection for wave new technologies to emerge fully-formed in digital format

- Ongoing: 2nd Offset US developed precision-guided munitions (PGMs), C4I (command, control, communication, computers and information) systems, and RSTA (reconnaissance, surveillance, targeting and acquisition) technologies,

- Subsequent RMA: digital battlefield and its vulnerabilities.

3. DIFFUSION AND LATENCY

- Driving forces of **digitization** and **innovation acceleration** give rise to two emergent phenomena: **diffusion and latency**.

- **Diffusion**: spread of weapons and weapons-related information and technology, increasingly through digital means or digital transfer, despite the existence of regimes and regulations to inhibit.

- **Latency**: the "maturing potential" of emerging or evolving technologies that have been transferred or otherwise already acquired. Once "mature," acquired technologies can fully empower users—both militarily and politically. "Technical surprise."

- Diffusion and latency are inextricably linked.

HOW DIFFUSION WORKS

- No single definition or shared understanding of nature and trajectory of military innovation.

- Hierarchical view: innovations emerge from the most advanced, largest centers of production (hubs) then spread outward.

- Spatial view: diffusion occurs as a function of spatial proximity.

- Digital diffusion: augments vulnerabilities like hacking and increasing number of users.

THE PROBLEM WITH ARMS CONTROL

- Arms control (AC) is traditional response to new technologies (Nye, 2015).

- However:

  - AC designed to manage actual physical weapons

  - Many AC agreements actually bargain away obsolete last-gen weapons and designs

  - CSBMs rely on what can be seen and counted.

NEWER THREATS: REGULATION VS. DIFFUSION?

- Cyber threats

- Additive Manufacturing

- Synthetic Biology

- AI, Machine Learning, Robotics, Autonomous Systems

TECHNOLOGY NOMENCLATURE

Emerging	Novel technologies currently under development and that have come into existence in the last **10-15 years**, awash in unknowns.
Evolving	Technologies already employed in some form for military purposes, but are either undergoing **significant refinements** or **enhancements**, or are **converging** with newer technologies.

Disruptive	Poised to **alter traditional approaches** to security and warfare; "**warfare revolutionizing**," "**bolts from the blue;**" capable of challenging laws of war.
Enabling	Capable of **augmenting** or otherwise contributing to the **creation or enhancement of military capability**; or the **military application of a dual-use technology.**

Convergence	Often result in emerging technologies; one technology augmenting another.

CYBER THREATS

- Threat types: cyberattacks, cyberexploitation.

- Emerging, evolving, enabling, disruptive technology.

- One of the biggest risks is losing state control over nuclear weapons (Caves and Carus 2014).

- NATO: domain of warfare

- Still defining what it means to launch a cyber attack.

- Barriers to use of arms control: verification, attribution are impossible; industry has vested interest.

- Alternatives: restraint, safeguards, accepting vulnerability.

ADDITIVE MANUFACTURING

- Evolving (30 years), dual-use, enabling technology.

- Can contribute to diffusion and latency.

- Efforts at regulation have not borne real fruit.

- Nuclear threats ➢ NSG

- Conventional threats ➢ Wassenaar Arrangement

- Stumbling blocks: innovation concern, cognitive complexity, un-traceability of digital transfers.

SYNTHETIC BIOLOGY

- New advances in gene editing: . CRISPR technology

- Low cost, highly available through legitimate markets.

- Enabling Technology: could be used to create lethal viruses with relative ease and speed.

- Diffusing the ability to create a bio-weapon.

- Rapidly evolving, difficult to predict.

- Biological weapons convention (BWC): CRISPR outside scope

AI/MACHINE LEARNING/ROBOTICS

- "Autonomous systems" built on advances from A.I., machine learning and robotics.

- Ex: Autonomous systems + software and communications subsystems ➢contribute to military capabilities like unmanned ISR.

- Evolving, enabling, dual-use technology that contributes to latency.

- Evolved from significant commercial advancements.

- Digital, open-source, dual-use ➢ rapid diffusion

- Numerous unknowns about militarization.

- Arms control: Campaign to Stop Killer Robots, inhibited by innovation concern, cognitive complexity.

PATTERNS IN REGIME MODERNIZATION EFFORTS

- Complementing Agreements: export guidelines, create or reinforce norms, interpret and apply international law.

- Updating successful often in response to a crisis.

- Updating control lists to manage emerging technologies otherwise a cumbersome process with low success rate.

- Frequent concern of stifling innovation; industry objection.

- Problems in understanding and predicting 2nd and 3rd order effects; cognitive complexity.

NUCLEAR REGIME MODERNIZATION

Nonproliferation Treaty (NPT) (1968) Example:

- **Zangger Committee** (1970) formed to implement NPT's Article III requirement that member states adopt export controls over material and equipment that could fissionable material.

- **Nuclear Suppliers Group** (1975) created in response to India's first nuclear test. Prevent dual-use technologies from being used to develop nukes.

- **NSG Control List Update** (1991): in response to crisis of Iraq's weapons program.

- Recent regime erosion: DPRK, Iran, NNWSs, 2015 RevCon

CONVENTIONAL REGIME MODERNIZATION

Wassenaar Arrangement (1996) (replacing COCOM) Example:

- 2013 effort to broaden scope by adding software to the list of controlled items, specifically monitoring software and network communications surveillance systems.

- Targeted preventing oppressive regimes from using "intrusion software," overly broad agreed language of proposed controls unintentionally "caught" dual-use software used for monitoring systems and providing security patches.

- Industry objected, WH called for do-over in 2015, discussion ongoing.

CONVENTIONAL REGIME MODERNIZATION

Missile Technology Control Regime (1987) Example:

- Restricts export of missiles and dual-use technologies used as delivery systems for WMD.

- 1992 modernization effort to add UAVs to annex.

- 2016 update to include missile mission software.

- **Complementary regimes sought** (2016): U.S.+40 issued Joint Declaration for Export and Subsequent Use of Armed or Strike-Enabled UAVs.

- Recent violations, proliferation failure, and U.S. erosion, nonmember states.

UAVS: CROSS-REGIME HARMONIZATION

- On **MTCR** control lists.

- UAV-related goods on **both Wassenaar Arrangement's control lists** (dual-use and munitions).

- Discussion over governance of UAVs has also taken place at meetings of the United Nations Convention on **Certain Conventional Weapons** (CCW) (regulates weapons that are deemed to be inhumane as a function of being excessively injurious or having indiscriminate effects).

CYBER THREATS: THE BAN MODEL?

1. **Russia's 2011 Intl Code of Conduct for Information Security at UN**.
    - Mirrored conventional regime modernization: innovation concern.
    - New obstacles:
        a. Application of international law?
        b. Lack of consensus on "cyberweapon"
        c. Problem of attribution,
        d. Moving target, constantly evolving
        e. Differing state approaches to privacy
2. **US-China 2015 bilateral code-of-conduct** agreement: cooperate on mutual requests for info, refrain from corporate espionage and theft of IP, continue to cooperate. Model for U.S.-Russia bilateral agreement?

WHAT IS TO BE DONE?

1. Modernize existing regimes

2. Assess the treat

3. Identify cross-technology trends

4. Engage with arms control alternatives

1. CONTINUE MODERNIZATION

- Partial, near-term solution

- Accelerate pace of updating control lists

- More transparency into working group meetings

- Increase coordination: interagency, internationally, with industry

2. THREAT ASSESSMENT

- Arms control efforts must begin with threat
- **Mapping innovation landscape**
- Applications of emerging technologies
- Timelines for their development
- Likely demand or users

3. IDENTIFY CROSS-TECH TRENDS

Stages of Impact:

- 1st order: Battlefield Effects, Regulatory Impact

- 2nd order: Diffusion

- 3rd order: Convergence

- 4th order: Alliances

4. ARMS CONTROL ALTERNATIVES

- Unilateral and multilateral **destruction agreements** for last-gen weapons that can end up on black market.

- Get out on **defense**: partner with industry to develop countermeasures and enhanced surveillance, capitalize on and invest in research and development of increasingly sophisticated means of detecting, tracking and monitoring lethal weapons capabilities and built-in countermeasures.

- Look abroad for partnerships in leading new nonproliferation agenda. Increase cooperation with allies for oversight.

STATE AND FATE OF ARMS CONTROL

- Existing regimes are being eroded.

- Arms control has evolved over time: information is everything.

- Weapons are increasingly digital.

- Increased demand for digital weapons information.

- Transparency in digital realm impossible.

CONCLUSION

- Plagued by **compliance and efficacy issues**, regimes and controls in place will likely have a limited lifespan if left alone.

- Though the regimes and controls aren't ineffective, per se, challenges **signal the need for strengthening and modernizing** to avoid potential backsliding abrogating or abolishing agreements brings.

- Modernize existing regimes, threat assessment, identify cross-tech trends to work efficiently across threats.

- Understand limits of regulation and pursue alternatives.

Thank you!

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"We now have 570 snowballs to your 525.
I just hope we never have to use them."