

# The Future Canadian Soldier and Enhancement of Human Performance



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Kingston, ON



**A Human Performance  
Enhancement Workshop**

Co-hosted by:



Human Performance Enhancement Workshop 2016  
Co-hosted by the CIDP and CIMVHR

Workshop Report

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Sara Greco (Queen's University)

**Table of Contents**

**TECHNICAL ABBREVIATIONS..... 2**

**KEY INSIGHTS ..... 3**

*PANOPTIC* ..... 3

*PERSPECTIVE* ..... 3

*PEOPLE* ..... 3

*PREDICTIVE* ..... 3

**DAY I: JUNE 8..... 4**

*OPENING REMARKS* ..... 4

*SECTION I: THE SOCIAL DIMENSION OF ENHANCEMENT* ..... 4

*SECTION II: TECHNOLOGICAL IMPLICATIONS FOR FUTURE USE*..... 6

**DAY II: JUNE 9 ..... 7**

*SECTION III: EASING PHYSICAL CHALLENGES THROUGH ENHANCEMENT* ..... 7

*SECTION IV: IMPLICATIONS FOR SOLDIER IDENTITY* ..... 8

*CLOSING REMARKS* ..... 9

**Technical Abbreviations**

- AF – Armed Forces
- CAF – Canadian Armed Forces
- CBRn – Chemical-Biological-Radiological-Nuclear
- DRDC – Defence Research and Development Canada
- HPE – Human Performance Enhancement
- HSP – Human Systems Performance
- LEAP – Load Effects Assessment Program
- PPE – Personal Protective Equipment

## **Key Insights**

### *Panoptic*

An understanding of what HPE is and its implications is a realm that intersects a vast array of disciplines and sub-disciplines. Such an observation speaks to the need to harbor a diverse range of expertise from an array of stakeholders.

### *Perspective*

Gaps in the literature on the topic of HPE include the impact of society's perspective on the soldier and the sentiments of the soldier. Relatedly, it is important to consider the implications of social views on government policy. As well, it is also pertinent to seek to understand how the societal views about HPE can impact factors such as recruitment, retention, and reintegration.

### *People*

Individuals are at the crux of debates surrounding HPE in a number of different ways but environment and context matter with respect to individual or collective sentiments vis-à-vis HPE. Attitudes may vary based on position, which includes realm (government, civil, military) rank (soldiers needs differ based on work), role (naval, air, and ground forces), and gender. It is crucial to consider the psychological ramifications of HPE and not just the physical consequences. Relatedly, it is important not to assume that soldiers automatically want access to these enhancement technologies. Individuals are individual, meaning that we are all unique mentally and physically. Such diversity needs to be considered when designing equipment and setting policy.

### *Predictive*

A crucial axis of consideration with regard to HPE relates to the challenge of looking prospectively to anticipate and appreciate the implications of HPE on a whole host of dimensions. While the methodological toolbox may be full for scholars and practitioners who are seeking to make future predictions, there was a ubiquitous sentiment that ultimately future outcomes cannot be prophesized.

**Day I: June 8***Opening Remarks*

Dr. Stéphanie Bélanger,<sup>1</sup> Dr. Stéfanie von Hlatky,<sup>2</sup> and Dr. Hans Christian Breede<sup>3</sup> set the tone for the workshop with their opening remarks. Their messages all pivoted on the importance of establishing a larger catchment area on the topic of human performance enhancement (HPE), by increasing the depth and breadth of actors engaged in the discussion, and opening the topic up to more challenging and pragmatic questions. Relatedly, Dr. Breede identified the challenge for the workshop would be to think about the implications for the soldier, the mission, and society at large. Each speaker noted the importance of using last year's workshop as a springboard toward greater development on the topic. Dr. Bélanger expressed appreciation for the variety of stakeholders who were in attendance. The importance of HPE was also discussed during these opening remarks. Dr. von Hlatky explained how HPE is one of the core research axes identified by the CIDP. The CIDP has established a website network on HPE and the expressed hope was that this workshop would further develop this resource.

*Section I: The Social Dimension of Enhancement*

The first panel provided an overview of the state of discussions surrounding HPE. Dr. Breede's presentation, "Capability and Connection: Social Cohesion and Soldier Enhancement," grounded HPE as a current reality in the armed forces. No longer should we consider science fiction as fiction, as this realm has and will continue to forecast what militaries, governments, and civil society face. Of particular interest and concern to Dr. Breede was the relationship between the civil and military realms. As it stands, the relationship between civil society and the military is manifested in a separation strain, one that, Dr. Breede fears will be further exacerbated by HPE. Dr. Breede focused on the importance of social cohesion, noting the positive relationship between social cohesion and outcome. He hypothesized that HPE will increase the risk of castification and adventurism, as the use HPE will lead to the establishment of a warrior class that will be easier to deploy. Dr. Breede also pointed to how such changes could lead to unwise foreign policy decision-making on the part of governments. Also important to reflect on, is that the impact of technological changes cannot often be foreseen or understood prospectively. In Dr. Breede's view, the use of HPE will likely undergo a cost-benefit analysis, wherein tradeoffs between factors such as cost, leverage, cohesion, and capability will be assessed. The caveat is that there is a clear distinction between cost-benefit analyses in the present and future tenses.

Subsequently, Dr. Keith Niall provided workshop participants with an overview of the state of the literature on HPE.<sup>4</sup> His presentation, "The Place of Canadian Research in Global

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1. Associate Scientific Director, Canadian Institute for Military and Veteran Health Research

2. Assistant Professor of Political Studies, Queen's University; Director, Centre for International and Defence Policy

3. Assistant Professor of Political Science, Royal Military College of Canada; Visiting Defence Fellow, Centre for International and Defence Policy; Infantry Officer, Royal Canadian Regiment

4 Defence Scientists, Defence Research and Development Canada

Advances on Human Performance Enhancement,” reflects a survey of the global literature on human system performance (HSP) carried out by the Defence Research and Development Canada (DRDC) and the National Research Council of Canada. It is pertinent to note that the focus of the survey was on HSP in general and not just in the military. With that said, Dr. Niall’s data illustrates that the literature overwhelmingly and disproportionately focuses on HSP in the military. Dr. Niall first explained the concept of HSP before delving into an analysis of the research done on HSP in Canada and around the world. He identified HSP as a concern to the Canadian Armed Forces (CAF) and one of proximate interest for the DRDC. The topic of HSP aligns with eight out of the 10 ‘hard problems’ faced by the CAF. Dr. Niall identified four integrated foci surrounding HSP: (1) computation and cognition; (2) performance and physiology, (3) automation, robotics, and telepresence; and (4) ethics. Currently, the DRDC and National Research Council of Canada are identifying which actors are working on HSP and to what extent are they collaborating within and between countries. In Canada, there is a large group studying HSP, and within this cohort, there is considerable collaboration among and between facilities. Dr. Niall presented a number of pertinent findings, including: a clear increase in HSP publications, an international research interest in HSP, and a disproportionate focus on computational/cognitive issues. This research project found the top collaborating countries (where publications have at least one international author) to be: the United States, Germany, and the United Kingdom. This statistic can be misperceived and so it is pertinent to note that the collaboration in the US is viewed as fragile. While US researchers may be viewed as large collaborators, they do not often collaborate more than two papers with more than one international author. To that end, proportionally, Switzerland has the highest proportional collaboration rate.

Dr. Annika Vergin’s<sup>5</sup> presentation, “A Perspective on the Way Ahead of Optimizing Performance of Operational Personnel,” spoke to the domestic and foreign challenges that HPE presents. The insights she provided came from a research project carried out by the Bundeswehr Office for Defence Planning. Dr. Vergin prefaced her presentation with an overview of the technologies and methods associated with HPE, which includes: biochemical enhancement (pharmacological, nutrition, and genetic), non-invasive enhancement (transcranial stimulations, exoskeletons, augmented reality, and silence speech interfaces systems), invasive enhancement (sensory neuroprotheses, deep brain stimulations, expansion of human sensors, and tissue engineering), and human biomonitoring. Dr. Vergin illustrated the importance of considering new scenarios that may materialize as a result of HPE, including: illegal contamination with pharmaceutical substances, the treatment of prisoners of war with substances that can affect the mind, and the sabotage of personal protective equipment (PPE). The Bundeswehr Office of Defence Planning sought to research the question of how to make technological knowledge usable for decision makers in the security or military sector. Using a creativity method with war gaming, the research drew a number of crucial considerations to the fore, including considerations relating to the use of HPE by enemies and allies. To that end, Dr. Vergin stressed the importance military education and collaboration.

Dr. von Hlatky served as the panel’s discussant; integrating comments and questions for the exploration of new considerations relating to HPE. Participants considered the relationship

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5. Regierungsbehörde, Bundeswehr Office for Defence Planning (Berlin, Germany)

between ethics and legalities. According to Dr. Niall, in Canada, the legal dimension of HPE is studied under the umbrella of ethics. Springboarding off of the topic of legal considerations, participants considered the implications of HPE on international law. At this point in time, there is no clear manifestation of HPE in the context of international treaties. Left unanswered was the question of what is being done about enhancements that are currently in use.

### *Section II: Technological Implications for Future Use*

Dr. von Hlatky considered the potential ability for HPE to propel gender equality in the Armed Forces. What initiated Dr. von Hlatky's research was the observation that practical documents on HPE, like op-eds and policy briefs, presented the question surrounding the use of HPE for women as an uninvestigated afterthought. She prefaced her presentation, "Emerging Technologies as a Way to Close the Gender Gap in the Armed Forces?" with an overview of the current state of gender equality in the Armed Forces (AF). She provided concrete evidence to support the existence of a gender gap in the AF. For example, even countries whose militaries have the highest rates of gender equality do not have rates in excess of 20% of women in their AF. Also worrisome is the finding that recruitment and retention percentages are either stalled or decreasing. Dr. von Hlatky presented a survey of the main arguments in the literature for why this gender gap exists, which included the following considerations: physical abilities, social dynamics, professional barriers, demand fluctuation, and low recruitment. She considered the potential impact of HPE on women in four different domains: robotics and automation, clothing and equipment requirements, cohesion enhancement, and cognitive enhancement. Theoretically, robotics and automation could improve strength and endurance, thus potentially narrowing the gender gap. Dr. von Hlatky cautioned that this line of thinking might be problematic because of the importance of equality of opportunity on social cohesion. Since most equipment has been designed for male body types, HPE – by way of tailored equipment – can help close gaps of inequality. Dr. von Hlatky echoed the sentiments of Dr. Breede when she spoke of the link between social cohesion and performance enhancement. Finally, with regard to the factor of cognitive enhancement, Dr. von Hlatky maintained that cognitive gender differences exist and that the AF should strive to capitalize on the cognitive strengths of each gender.

Dr. Eva Dickson's<sup>6</sup> presentation, "Improving Wearer Performance by Reducing the Burden of Chemical-Biological-Radiological-Nuclear (CBRn) Personal Protective Equipment in the Asymmetric Threat Environment: Next Generation Designs," served as an overview of current and prospective efforts to optimize soldiers' CBRn PPE. Within the realm of PPE, the focus remains on optimization instead of enhancement. Before delving into a summary of current and future CBRn PPE optimization endeavours, Dr. Dickson discussed why such protective equipment is worn, as well as the problems with past and current uniform models. CBRn PPE is worn to shield against hazardous material by attempting to protect all roots of entry. Most often, the use of CBRn PPE by soldiers is used as a deterrent for adversaries and for the psychological benefit it provides the wearer. Issues with past and current protective uniforms concern performance degradation, as well as health risks owing to the burden of the equipment. The impracticality of these uniforms is highly evident given the infrequency of their use. The move is now to thinking smartly about how this equipment is being used. Related to Dr. von Hlatky's

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6. Defence Scientist, Royal Military College of Canada; Defence Researcher, Defence Research and Development Canada



discussion of tailored uniforms, Dr. Dickson also commented on the importance of recognizing that there is more than one population of users and that a once size fits all approach to PPE is unwise. Dr. Dickson noted two types of wearers: first time users, who are general soldiers who often do not need PPE and specialist users, who are more likely to enter hazardous environments. The design challenge according to Dr. Dickson is to create uniforms that: are low profile, provide adequate protection, and mesh with ancillary equipment.

For his presentation, “Improve Soldier Performance: Issues and Perspectives, from a French Approach,” Mr. Gérard de Boisboissel<sup>7</sup> provided a French perspective vis-à-vis warrior enhancement equipment. Mr. Boisboissel relayed the conclusions drawn from the CREC Saint-Cyr Research Program. Mr. Boisboissel defined an enhanced soldier as one: with increased physiological capabilities; that has an expanded tactical environment; who has a lightened carry load; and whose equipment can provide medical support and an operational advantage. Pertinent to Mr. Boisboissel’s presentation was his discussions of the risks associated with HPE, which included: the potential for dependency, the high cost of this equipment, and the possibility of technological glitches. A large concern with respect to increasing technologies surrounds the duration and type of mission. Diversity is a crucial consideration, as soldiers can perform a diverse array of tasks in a particularly short time horizon. Mr. Boisboissel concluded with a call and caution to keep the human aspect of the soldier at the helm.

Dr. Bélanger served as this panel’s discussant. The focus of this discussion was in regard to the relationship between gender equality in civil society and the military. It is unrealistic to assume that perfectly equal gender proportions are on the immediate horizon. However, the important change is that social dynamics in the civil and military realms are healthy. A related concern is how to develop healthy social gender dynamics. One method is to increase awareness in both spheres.

## **Day II: June 9**

### *Section III: Easing Physical Challenges through Enhancement*

Ms. Linda Bossi’s<sup>8</sup> presentation, “The Impact of Soldier Clothing: Protection and Personal Equipment on Combat Task Performance and Survivability,” put the use of HPE into perspective by articulating the more urgent and immediate imperative is to ameliorate the most basic soldier equipment. Her focus was on the physical burden of protective equipment, as well how physical burden can lead to psychological burden. Unfortunately, the recommendation that soldiers not to carry more than 30% of their body weight is not adhered to. Instead, Ms. Bossi noted that the norm is for soldiers to carry their whole body weight. Given overload scenarios present themselves in operations and not in training, soldiers are not prepared for the encumberment. The reason for the overload, Ms. Bossi shared, is owed to new technologies. She explained that overload can lead to: injury, the inability to reach a destination and fight once there, which relates decreases in performance, slower movements, impaired target detection and marksmanship, and lower abilities to absorb orders. According to Ms. Bossi, soldier burden is reducible through initiatives such as: wise equipment purchasing, not having soldiers to bring

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7. Research Engineer, Ministry of Defence (France)

8. Ergonomist, Defence Research and Development Canada

civilian GPS systems, smart soldier training, the implementation of work/rest schedules, and route planning. Her focus, however, was on smart equipment purchasing decisions. Buying better can entail: requiring new equipment to be lighter than what it is replacing; determining weight tolerances of different pieces of equipment for different individuals; ensuring more effective weight distribution; and designing ergonomic kits with modularity, ventilation, and cooling. In Canada, little effort is made to ensure soldiers possess smart equipment and the result is soldier failure. Ms. Bossi also discussed the Load Effects Assessment Program (LEAP), which determines combat performance and survivability impact of soldier equipment/alternatives. Results from LEAPs indicate that weight, bulk, and reduced range of motion from equipment negatively impact performance.

The subsequent presentation, “Reducing Soldier Burden to Improve Performance and Reduce Injury,” given by Dr. Thomas Karakolis,<sup>9</sup> springboarded off Ms. Bossi’s. Dr. Karakolis’ presentation was also an application of the framework he presented at the previous workshop for evaluating new technologies. The framework for purchasing new technologies, particularly exoskeletons, is to ensure the equipment has high utility, which can be evaluated based on: anthropometric considerations, functional movement optimization, effect on simulated operational task performance, effect on operational performance, physical interaction with other equipment, and injury risk assessment. Results from new evaluation methods allow for proper assessment of this technology, and consequently, buttress the view of exoskeletons as seriously viable for the military. Dr. Karakolis outlined these new evaluation methods, explaining how it is now possible to: examine metabolic cost to see how much energy is expended by a soldier using an exoskeleton; assess how the exoskeleton impacts the soldier using electromyography and markers; and evaluate the physiological impact of lower-extremity exoskeletons during overload through the development of a system for biomechanical evaluation. Results from three types of testing environments – academic lab, applied lab, and field – indicate strong potential for exoskeletons. With that said, Dr. Karakolis cautioned that injury probability and its implications remain difficult to fully understand.

Dr. Niall serves as discussant to a panel that yielded an array of dialogue. During this time, attendees were informed that while cost estimations of exoskeletons are still preliminary, the cost of an individual system is around \$50,000-\$100,000. With that said, the mass production of this item will bring down its cost. The question of if and how soldiers can remove exoskeletons quickly in situations of distress was also raised. The hope is that situations of threat will not require soldiers to remove their exoskeletons. Another pertinent factor to consider in the removal of exoskeletons is the risk associated with leaving them behind for the enemy.

#### *Section IV: Implications for Soldier Identity*

The workshop’s fourth panel highlighted the ethical and moral implications associated with HPE. It began with Dr. Colin Farelly’s<sup>10</sup> presentation, “Enhancement and the Status Quo Bias.” Dr. Farelly sought to dislodge unfounded claims relating to the enhancement of humans. He drew an analogy between unfounded social and ethical arguments against bio-genetology and

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9. Defence Scientists, Defence Research and Development Canada

10. Associate Professor, Queen’s University

biomedical performance enhancement. Those who oppose human manipulation share the belief that such human interference is: unnatural, risky, and at the expense of our humility. In Dr. Farrelly's view, these arguments are about maintaining the status quo. Dislodging these arguments first requires us to distinguish between a concern (a con) and an objection (an all things considered assessment). He challenged the argument that biological enhancements are unnatural by showing that these practices are already apart of our repertoire. In Dr. Farrelly's view, aging itself is actually unnatural; and the reason we age is because we have artificially created environments and situations to protect against it. During this discussion he also mentioned the problem of speaking in dichotomous terms, noting that the natural/unnatural contrast is not an illuminating one. Dr. Farrelly refuted the second line of contestation – the belief that biological tweaking is too risky or costly – by showing how the risk of inaction is actually more costly. For example, it is important to consider the costs of making advancements in aging relative to the cost associated with the care of a growingly dependent elderly population. Dr. Farrelly questioned the validity of the third argument against biological enhancement by noting that a portion of our population is already undertaking such actions. To conclude, Dr. Farrelly echoed the sentiments of many in attendance when he noted the difficulty of anticipating future implications for HPE.

Dr. Bélanger presented her study, “The Impact of HPE on Soldier Identity,” wherein she sought to answer the question of how new technologies impact soldier identities. Her project consisted of a discourse analysis of testimonies with 75 male soldiers who were in combat arms in Afghanistan and/or the former Yugoslavia. Her work highlights the requirement to consider the impact of HPE on the overwhelming norm of war culture within the military. Dr. Bélanger articulated that her definition of war culture was consistent with the literature on the topic. War culture can be understood as a clan-like relationship where strong family ties between soldiers maintain *l'esprit de corps* and help soldiers suppress their fears and natural desire to feel in the face of danger, insofar as the fear of abandoning fellow soldiers was greater than the fear of fighting enemies. Dr. Bélanger noticed a series of pertinent common sentiments shared by Canadian soldiers, including: focus on the human aspect of missions, dissociation with civilian life, and emphasis on notions of invincibility and soldier superiority. Dr. Bélanger highlighted a crucial dichotomy of HPE and war for the soldier. That is, she articulated that soldiers concomitantly feel guilty and worthless when they do not contribute adequately, on the one hand, and fearful and weary of losing their humanity and the human aspect of their missions, on the other hand.

Dr. Breede noted a few pertinent threads that weaved throughout the panel's presentations, including themes like the balance between what is categorized as natural and unnatural, the importance of the organization of the military, and relatedly, the need to consider the views of the soldier vis-à-vis HPE technologies. It remains important to consider what the distinction between invasive and non-invasive technologies signifies for policies and practices relating to HPE. For example, should soldiers be selectively screened based on their genomes and what would this situation look like empirically for human rights?

### *Closing Remarks*

Workshop organizers, Drs. von Hlatky, Breede, and Bélanger articulated their excitement about the advancements made over the last two days. Compared to the preceding workshop, Dr. von Hlatky noted an increase in topical diversity. It is her hope that proceeding workshops will

continue to harness the strengths associated with marrying the academic and applied worlds, as well as to address the gap surrounding the relationship between ethical and legal concerns, and HPE. Dr. Breede's hope is that the developments that emanated from the workshop will allow the CIDP to further expand its online HPE resource. Dr. Bélanger's hope is that this collaborative body will increase its collaboration with international actors while still maintaining a strong cohesive identity.