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"Looking up to our leaders?"

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ABSTRACT

Using height as an objective physical attribute, it will be proven that the Canadian Forces (CF) institution is able to better select its leaders than our Society. This will be accomplished through statistical analysis of the obtained data and a review of the leadership traits theories and scientific literature which focuses on physical attributes.

Chapter Two provides a quick review of the different leadership schools with more emphasis being placed on the Traits and Information-process schools. It will be demonstrated that since the beginning of modern literature on leadership (Traits school), the attribute of being tall has always been one of the traits being used to describe a leader. As for the Information-processing school, it will be explored to see how perception can be affected by mental constructs or the halo effect. Finally, the CF perspective on leadership will be provided and compared with the main existing theories.

Chapter Three will look at many of the different aspects of stature in our Society. Studies showing the relationship of intelligence and occupations versus an individual's height will be reviewed along with others proving that stature could even be a larger discriminator than gender or racial origin when it comes to remuneration. The influence of height on politicians or CEOs of large companies will also be briefly explored to finally arrive at the overall conclusion that our society unfortunately uses height as a discriminator when selecting its leaders.

Chapter Four will prove that except for the males within the Navy, the height bias doesn't exist in the CF promotion system. It will also demonstrate that there is no statistical difference in height between the generals rank and the officers group. In addition, it will be established that

when an institution like the CF deviates from a relatively objective promotion system to a selection system, a height bias is present, as proven in the case of senior versus "regular" CWOs. Furthermore and in an unanticipated way, it will be first shown that there is a definite and statistical difference in height between officers and Non Commissioned Members (NCM) in almost all CF services and this for both males and females. Secondly and finally, it will be found that there seems to be a form of obstacle for shorter people at the junior rank level of both male NCM and officers as those junior ranks are statistically shorter than the respective subsequent ranks.

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CHAPTER 1 – INTRODUCTION

"I failed to make the chess team because of my height", Woody Allen.

The Canadian Forces (CF) is a reflection of the Canadian society. Although its values are very similar (as it should be), it is also unique and differs in many ways because of its structure and exclusive profession. Some of the distinctive but not exclusive characteristics of the CF are that military leaders are always promoted from within the CF military organization following a relatively objective promotion system. What will be explored in this paper is that doing so provides the CF the indirect benefit of being able to more objectively select its leaders than the Canadian Society in general.

Using height as an objective physical attribute (from data obtained from the company Logistik UniCorps Inc., see Annex B), it will be proven that the CF institution is able to better select its leaders than our society. This will be accomplished through statistical analysis of the obtained data and a review of the leadership traits theories and scientific literature focussing on physical attributes. Those already familiar with the different leadership theories or the implications of height in our society might want to skip the next two chapters and go directly to Chapter Four for the data analysis portion of the paper.

Chapter Two provides a quick review of the different leadership schools with more emphasis being placed on the Traits and Information-process schools. It will be shown that since the beginning of modern literature on leadership, the attribute of being tall has always been one of the traits being used to describe a leader. As for the Information-processing school, it will be explored to see how perception can be affected by mental constructs or the halo effect. Having

an understanding of those two schools should provide the minimum background information necessary to put in better perspective the next chapters. Finally, the CF perspective on leadership will be provided and compared with the main existing theories.

Chapter Three will look at many of the different aspects of height in our Society starting with the fact that height is an already recognized variable used by many scientists to measure societies' health. Studies showing the relationship of intelligence and occupations versus an individual's height will be reviewed along with others proving that stature could even be a larger discriminator than gender or racial origin when it comes to salary or position in a company. The influence of height on politicians or CEOs of large companies will also be briefly explored to finally arrive at the overall conclusion that our society unfortunately and unknowingly uses height as a discriminator when selecting its leaders.

Chapter Four will look at the relationship of rank versus height in the CF by looking at the average height by rank, gender and trade of a very large number of Canadian military personnel. This will provide the proof that Canadian military leaders are mostly promoted based on their merits or at least that the height bias articulated in Chapter Three is not a factor in their promotions. Conversely and along the way in achieving the above, it will be discovered that the entry-level ranks of both officers and NCM are shorter than all the subsequent ranks and that as an exception to the previous affirmation of objectivity, selected CWOs are definitely favoured by the height bias. All of the previous "discoveries" will then be linked with some of the different theories explored in Chapter Two and Three.

CHAPTER 2 – LEADERSHIP

What is Leadership?

In the last 100 years, more than 65 different definitions or classification systems have been created and written to define the concept of Leadership and what it is.[1] Although the aim of this chapter is certainly not to add to the list or to make an inventory of it, it is necessary to define and remind the reader of the larger context of leadership before some of the specifics can be introduced.

Although leadership is easy to identify when observed, it is certainly not precisely defined. As an example, one author, Andrew J. Dubrin, defines leadership ". . . as the ability to inspire confidence and support among the people who are needed to achieve organizational goals."[2] while another one, Peter Northouse, defines it ". . . as a process whereby an individual influences a group of individuals to achieve a common goal."[3]

Although similar, both definitions offer some subtle differences. On the similarity side, both need goals as well as a group. "Leadership involves influencing a group of individuals who have a common purpose."[4] and this common purpose is a goal toward which the group must try to get to. As for the first and relatively minor of the differences, the Northouse definition is about

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[1] Peter G. Northouse, *Leadership Theory and Practice, Fourth Edition* (California, USA: Sage Publications, 2007), 2.

[2] Andrew J. Dubrin, *Leadership: Research Findings, Practice and Skills, 6th Edition* (Ohio, USA: South-Western Cengage Learning, 2010), 2.

[3] Northouse, *Leadership Theory and Practice, Fourth Edition*, 3.

[4] Ibid., 3

influencing while Dubrin is about inspiring and gaining support. The main difference is actually the fact that for the Dubrin definition, it is an ability versus a process for the Northouse definition. The meaning of this is that a process is a transactional (or bidirectional) event between a leader and his or her follower (where both actors affect each others) while an ability is an attribute that can be associated to an individual.

Because military personal must understand what is expected from them in terms of leadership and not rely on others' definitions, the CF has devised its own definition of military applied leadership. Leadership is therefore defined as ". . . directly or indirectly influencing others, by means of formal authority or personal attributes, to act in accordance with one's intent or a shared purpose."[5]

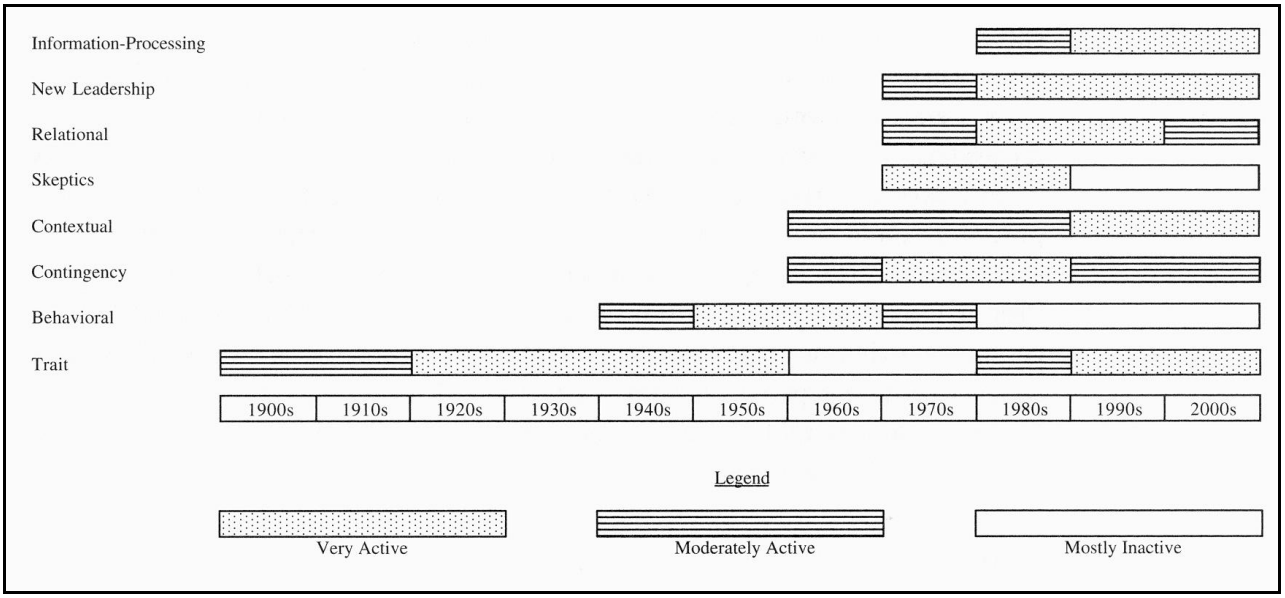
The previous paragraphs have shown some of the main definitions of leadership and it must be understood that there are still many others that are similar but dissimilar. Many of the definitions are also based on the different theories trying to analyse what is leadership and those theories or schools of thought are numerous. The following part will introduce in a very broad way what are the different main schools of leadership.

The Major Schools of Leadership

Antonakis, Cianciolo and Sterberg in their leadership book published in 2004 have divided leadership research into eight major schools. Those schools of thought and their associated level of activity throughout the last century are outlined in Figure 2.1.

[5] Canadian Forces Leadership Institute, *Leadership in the Canadian Forces: Doctrine* (Kingston, ON: Canadian Defense Academy, 2005), 3.

Figure 2.1: A Brief History of the Major Schools of Leadership



Source: Various, *The Nature of Leadership*, eds. Jonhn Atonakis, Anna T. Cianciolo and Robert J. Sternberg (California, USA: Sage Publications, 2004), 7.

Trait School

The oldest of the leadership theories, it is sometimes called the "Great Man" theory. The general idea is that leaders have identifiable and different characteristics than from followers. Many researchers tried to identify those leader characteristics without much success and this school became less popular. However, recent successes, like a positive and strong correlation between leadership and intelligence have some researchers taking a second look at it.[6]

[6] Northouse, *Leadership Theory and Practice, Fourth Edition*, 6.

Behavioral School

This was a response to the original failure of the Traits school. This behavioral school is about the behaviour of the leaders and their treatment of their followers. It fell into disfavour when it was realized that leadership success was contingent on the situation.[7]

Contingency School

This school is mostly about the effectiveness of a leadership type based on the leader-member relationship, the task structure and the associated positional power.[8]

Contextual School

This theory has somewhat superseded the contingency theory and is about the recognition that leadership is embedded within the environment, structure, and technology of organizations.[9]

Skeptics School

This school of thought suggested that leaders were mostly irrelevant and that what was perceived as leadership outcome was in fact the outcome of outside variables. Although not popular anymore, this school asked many questions about the validity of previous leadership research, thus indirectly enforcing stronger and more reliable methodologies.[10]

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[7] Ibid., 7

[8] Ibid., 7

[9] Ibid., 42

[10] Ibid., 8

Relational School

This school or theory is about what has been termed the leader-member exchange theory whereas the nature and qualities of the relations is described and analyzed both in terms of input and output.[11]

New Leadership School

This theory was created to account for what has been described as transformational leadership; where a leader's behaviour will inspire his or her followers with a sense of purpose and self-interest will become subordinate to the greater good.[12]

Information-Processing

This school is about understanding how cognition is related to the enactment of various behaviors. More specifically, ". . . understanding why a leader is legitimized by virtue of the fact that his or her characteristics match the prototypical expectation that followers have of the leader."[13]

<u>More on Traits and Information-processes</u>

Because height as a physical attribute of leadership will be explored in the next chapter, the traits theory would seems to be the logical choice for further exploration. However, there

[11] Ibid., 8

[12] Ibid., 9

[13] Ibid., 9

might be more than the traits theory at play and this is why the information-processing theory will equally be explored.

Traits Shool

"Born to be a Leader" is the epitome of the leadership school of traits. It is part of the general idea that some identifiable characteristics, physical or not, as well as natural talents or lack thereof might differentiate a leader from a follower or at least influence the growing-up of a leader. Some of those unique factors might be physical (i.e. height or weight), personality features (i.e. extraversion or intelligence) or ability characteristics (i.e. speech fluency or physical agility).[14]

In his book, Northouse states that the trait approach (or school) is very different from the other ones because it focuses exclusively on the leader and not on the follower or the situation. It has therefore the advantage of being more appealing and straightforward than other leadership theories. In other words, the trait school is interested in the traits that leaders exhibit and those who have these traits.[15] Northouse also went through a review of the different leadership trait studies that were done in the last century and provided the main outcome of the identified traits. These can be seen in the following table (Table 2.1). From these studies, Northouse also extracted the most consistent traits in order to provide a more "definitive" or major set of traits. Those major leadership traits were defined as: Intelligence, Self-confidence, Determination, Integrity and Sociability.[16]

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[14] Ibid., 4

[15] Ibid., 23

[16] Ibid., 19

Table 2.1: Studies of Leadership Traits and Characteristics

Stogdill (1948)	Mann (1959)	Stogdill (1974)	Lord, DeVader, and Alliger (1986)	Kirkpatrick and Locke (1991)
Intelligence Alertness Insight Responsibility Initiative Persistence Self-confidence Sociability	Intelligence Masculinity Adjustement Dominance Extroversion Conservatism	Achievement Persistence Insight Initiative Self-confidence Responsibility Cooperativeness Tolerance Influence Sociability	Intelligence Masculinity Dominance	Drive Motivation Integrity Confidence Cognitive ability Task knowledge

Source: Northouse, *Leadership Theory and Practice, Fourth Edition,* 18

The first criticism of the trait approach is that it never succeeded in providing a definite list of leadership traits and that many studies were confusing or vague. The second one is the fact that, being only centered on the leader, it doesn't take into account the situation where a leader can be effective in one and not in another. It equally does not consider the leader-follower relationship and the two-ways influence of one versus the other. Perhaps the most relevant criticism of this approach was the high degree of subjectivity involving the authors of many studies on leadership traits.[17]

The demise of this approach to leadership occurred during the 1940-1950 decades and more emphasis was then put on the behavioural and contingency schools. One such situational example which shows that leadership traits could not be universally applied to all leaders is when one study found out that informal leaders of prison inmates tended to be homosexual, neurotic

[17] Ibid., 25-26

and psychopathic.[18] However, there was a kind of re-birth of the trait school after 1980s when Lord, DeVader and Alliger used new statistical validation methods to isolate and correct the correlations of the Mann study. This meta-analytical review provided many mathematically solid conclusions and many of them were further validated with new studies. In addition, the arrival and subsequent importance of the new Leadership school or transformational leadership helped the resurgence of the Trait school.[19] The following extracts are representative of how this school of thought is now perceived:

> Traits alone, however, are not sufficient for successful business leadership – they are only a precondition. Leaders who possess the requisite traits must take certain actions to be successful (e.g. formulating a vision, role modeling, setting goals). Possessing the appropriate traits only makes it more likely that such actions will be taken and be successful.[20]

> In short the trait approach is alive and well. It began with an emphasis on identifying the qualities of great persons; next it shifted to include the impact of situations on leadership; and most currently, it has shifted back to reemphasize the critical role of traits in effective leadership.[21]

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[18] C. Schrag, "Leadership among Prison Inmates," *American Sociological Revue* 19 (1954), 37-42.

[19] Various, *The Nature of Leadership*, eds. John Antonakis, Anna T. Cianciolo and Robert J. Sternberg (California, USA: Sage Publications, 2004), 108.

[20] Shelley A. Kirkpatrick and Edwin A. Locke, "Leadership: Do Traits Matter?" *The Executive* 5, no. 2 (May, 1991), 49, http://www.jstor.org/stable/4165007.

[21] Northouse, *Leadership Theory and Practice, Fourth Edition*, 16.

Information-Processing School

Whereas many theories focussed on external and observable outcomes, the information-processing school has always focussed on what is going on in the heads of the actors playing a role in the leadership act, namely the leader and the follower or subordinate. This school looks, for example, at why a supervisor uses a certain behavioural style versus another one depending on the situation or how a subordinate decides whether his or her supervisor is a leader. This "Behavior, whether it is a leader's or a subordinate's, does not simply occur; instead behaviour is proximally determined by intermediary cognitive processes."[22] and "Thus whereas information-processing theories still define leadership as influence, they do so by examining the cognitive mechanisms that mediate the influence process, rather than focusing on overt behavioural displays (e.g., transformational behaviour)."[23]

The generic idea about information-processing is the schemata association. Schemas or schematas are interconnected symbols or categories of information stored in our long-term memories. "Schemata assist us in interpreting and making sense of our surroundings and in generating adaptive response."[24] This is how a subordinate might categorise or perceive his or her supervisor as a leader or not, based on embedded expectations or recognition patterns. In other words, if the supervisor fits the idea of what a leader is supposed to look, then the subordinates would associate the leader attribute to the supervisor and behave accordingly.

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[22] Various, *The Nature of Leadership*, 126.

[23] Ibid., 126

[24] Ibid., 126

"Indeed, research has demonstrated that leadership emergence is contingent on an individual's ability to flexibly adjust his or her behaviour to the current context."[25] This also means that the more experienced or knowledgeable the leader is, the more flexible he or she should be because "Leaders with better or more broadly developed schemata and knowledge should perform more effectively than those leaders with poorly developed leader knowledge bases."[26] This is because the more schemata or type of leadership experience a leader has, the better he or she is able to fine tune the behaviour that best fits a given situation.

An interesting example is regarding the impact of the leader or supervisor categorizing his or her subordinates and what has been called the self-fulfilling prophecy or the Pygmalion effect. This one is best described as ". . . the process through which the expectation that an event will occur increases the likelihood of the event's occurrence."[27] The specific example in question is about qualified professional instructors of military recruits in the Israeli Defence Force and their subordinates (recruits). The instructors were told before a course that some of their incoming recruits had been previously assessed as having superior command potential while others had only normal or unknown potential. Unbeknownst to the instructors, the attribution of the high potential command had been completely random but the (false) information was enough to change their behaviour toward the members of the recruits group.

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[25] Ibid., 128

[26] Ibid., 128

[27] Ibid., 131

The results of the experiment showed a very strong correlation between the top scorers of the course and those given the high-potential attribute.[28]

How does someone make the distinction between a leader and a non-leader? Using his or her schemata of what is a prototypical leader (which could have traits like intelligent, dedicated, goal-oriented, etc.), a person would assign this leader attribute to the person in the group who is the most conforming to his or her schemata or stereotypical framework. Therefore, ". . . the decision to label an individual as a leader depends on the extent to which the features of a target overlap with the features that distinguish the leader category or prototype."[29] This is an interesting finding to consider when the definition of a leader has been proven to vary according to culture. "Inconsistencies in the prototypes [of leaders] across cultures suggest that leaders may have difficulty transitioning across cultures."[30] It shows that although there is a leadership core commonality independent of cultures, enough differences exist so that a person might be perceived as a leader in one culture and not as one into another culture.

The information-processing school has received limited attention by the academics and researchers compared to other leadership schools.[31] As an example, it is not even mentioned in the index of the Northouse 2006 book. However, it could be considered a good complement or supplement to the trait or the behavioural school as it is a natural bridge between those two schools while offering another point of view on leadership research and knowledge.

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[28] Ibid., 131

[29] Ibid., 138

[30] Ibid., 140

[31] Ibid., 147

Leadership and Society

All economic and political systems as well as business ventures owe their continued existence to the successful guidance of human beings.[32] "Leadership is required to direct and guide organizational and human resources toward the strategic objectives of the organization and ensure that organizational functions are aligned with the external environment."[33] Because this ability to lead others effectively is a precious and sought-after quality, organizations are always searching for executives with the proper leadership training or experience. Thus, this precious leadership requirement becomes even rarer as one climbs up to the organization's highest levels while the complexity of such positions requires a very large range of leadership skills.[34]

The term *leader* has a positive connotation for most people. To be called a leader is generally better than to be called a follower or a subordinate. In contrast, the term *follower* has virtually disappeared in organizations, and the term *subordinate* has fallen out of favour. The preferred term for a person who reports to a leader or manager is now *team member*, *group member* or *associate*.[35]

Not all leadership positions provide personal satisfaction. There are many sources of satisfaction as well as frustrations coming with leadership positions and those sources are never in equal proportions. However, it can safely be assumed that there is more positive than negative

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[32] Jeffrey C. Barrow, "The Variables of Leadership: A Review and Conceptual Framework," *The Academy of Management Review* 2, no. 2 (Apr., 1977), 231, http://www.jstor.org/stable/257906.

[33] Various, *The Nature of Leadership*, 5.

[34] Dubrin, *Leadership: Research Findings, Practice and Skills, 6th Edition*, 3.

[35] Ibid., 16

because of the general positive connotation. Following is a table providing identifiable sources of satisfaction as well as frustration for leadership positions.

Table 2.2: Satisfaction and Frustration of being a leader

Satisfaction of Leaders	Frustration of Leaders
-Feeling of power and prestige -Chance to help others grow and develop -High income -Respect and status -Good opportunities for advancement -Feeling of "being in on" things -Opportunity to control money and other resources	-Too much uncompensated overtime -Too many "headaches" -Facing a perform-or-perish mentality -Pursuit of conflicting goals -Loneliness -Too many problems involving people -Too much organizational politics -Not enough authority to carry out responsibility -Being perceived as unethical, especially for corporate executive

Source: Dubrin, *Leadership: Research Findings, Practice and Skills, 6th Edition*, 16-20

One of the important aspects of the above table is the high income associated to being a leader. This is because there are many sources of research linking traits to salary and many linking traits to leadership. Assuming a link between the previous associations, both salary and leadership could therefore be subjectively interchangeable. This would therefore allow, for example, the use of salary as an intermediate to draw inferences about how a trait is affecting leadership.

In the business world, the transformational leadership school has been looking a lot at charisma which could be defined as the ". . . seemingly supernatural charm that some leaders exude."[36] "This buzz that the charismatic CEO creates is exactly what executive-search teams in

[36] Ken Hunt, "We Don't Need another Hero," *Report on Business*, February 2008, 2008, 22.

the United States tend to look for when selecting a new leader."[37] However, a recent study found that a company's performance and its CEO's charisma were in no way related despite the perception of the CEO charisma being related to company performance.[38] This is the halo effect, a psychological bias which associates specific attributes based on unrelated general observations. "If someone is attractive, we tend to assume they will also be intelligent. If a company is successful, our general positive feelings about the state of that company tend to translate into specific feelings about the qualities of the CEO, which makes it difficult to assess whether charismatic CEOs are more successful [based on the previous referred study, they are not], or simply appear to be."[39] Using the information-processing leadership school, this halo effect could in fact be a schemata that some individuals or even a society have with regard to charisma and successful business. Schemata are useful as they permit human beings to rapidly grasp a situation in a short time but they could also be detrimental if not recognized as bias when they are based on incomplete or misleading information.

Leadership and the Canadian Forces

As defined in the Canadian Forces (CF) doctrine, leadership in the CF is about the defence of Canada and of its interests while contributing to international peace and security.[40] Leader effectiveness in the CF is therefore closely related to the effectiveness of the CF as a

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[37] Ibid.24

[38] Bradley R. Agle and others, "Does CEO Charisma Matter? an Empirical Analysis of the Relationships among Organizational Peformance, Environmental Uncertainty, and Top Management Team Perceptions of CEO Charisma," *Academy of Maagement Journal* 49 (2006), 161-174, http://images.usnews.com/usnews/biztech/features/CEOcharisma.pdf (accessed 23 February 2010).

[39] Hunt, *We Don't Need another Hero*, 22.

[40] Canadian Forces Leadership Institute, *Leadership in the Canadian Forces: Doctrine*, 2.

whole. "Collective effectiveness in the CF can be uniquely defined in terms of five major dimensions: mission success, internal integration, member well-being and commitment, external adaptability, and the military ethos."[41]

The CF philosophy of leadership is based on the key principles of distributed leadership and values-based leadership. Distributed leadership means that the essential functions of leadership should be shared to varying degrees with peer and subordinate leaders, that the leadership potential of all with formal authority should be fully developed and exploited, and that the leadership potential of all CF members should be given an opportunity for development and expression. Values-based leadership means for its part that leaders are to be guided in their decisions and actions by the institutional values of effectiveness.[42] The CF philosophy of leadership can therefore be considered very large and even welcoming in term of leadership potential as the distributed leadership functions means that everyone should see their potential developed, trained and even tested.

The CF leadership doctrine has identified five essential domains that any CF leader should have in order to be an effective leader.[43] Those are: knowledge and skills, cognitive ability, social capacities, personality traits, and professional motivation and values. Although important, the CF doctrine also adds the caveat that there is not a definite list of essential qualities or attributes to be a leader in the CF or that having those attributes would automatically lead to effective leadership.

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[41] Ibid., 3.

[42] Ibid., 10-11

[43] Ibid., 19

In the Unites States, Kirkpatrick and Locke have stated in one of their papers that ". . . military leaders do not have traits identical to those of business leaders."[44] and that "Traits alone, however, are not sufficient for successful business leadership—they are only a precondition."[45] Using the Kirkpatrick and Locke main traits from table 2.1, the following table (2.3) is trying to connect those traits with those of the CF doctrine. What can be seen right away is that they are quasi-identical as the CF doctrinal definition of the personality traits includes both integrity and self-assurance.[46] The main difference therefore resides with the business (or civilian) side having the Drive trait instead of the Social capacities trait. However, both the CF doctrine and Kirkpatrick and Locke are in agreement, when they state that the list is neither exhaustive nor a guarantee of successful leadership.

Table 2.3: Comparison of leader traits—Business versus CF doctrine

Kirkpatrick and Locke (1991)	CF doctrine
Drive	Social capacities
Motivation	Professional motivation and values
Integrity	Personality traits (include integrity)
Confidence	Personality traits (include self-assurance)
Cognitive ability	Cognitive ability
Task knowledge	Knowledge and skills

Source: created by the author based on the CF leadership doctrine and the above Table 1

[44] Kirkpatrick and Locke, *Leadership: Do Traits Matter?*, 49.

[45] Ibid., 49

[46] Canadian Forces Leadership Institute, *Leadership in the Canadian Forces: Doctrine*, 19.

CHAPTER 3 – STATURE AND SOCIETY

Introduction

We live in a society where physical appearance matters, not only because it affects how others respond to us but also because it affects how we view ourselves. Physical traits clearly play an important role in workplace interactions and outcomes, and there is active literature which focuses on how attractiveness, weight, and body image affect workplace interactions and outcomes.[47]

"Looking up to our leaders" is a common expression which implies that the followers or subordinates look up to their taller executives or supervisors. That might be why the leadership school of traits had for a long time used stature as an attribute of a leader. Even today, "Height is widely believed to be an important ingredient of professional and personal success."[48] Height, from a psychobiological perspective, can equate to power and therefore it demands respect.[49] Not so long ago, height was explicitly considered in hiring decisions, but what was once explicit may now be implicit as height continues to be a factor in terms of promotions and pay.[50]

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[47] Timothy A. Judge and Daniel M. Cable, "The Effect of Physical Height on Workplace Success and Income: Preliminary Test of a Theoretical Model," *Journal of Applied Psychology* 89, no. 3 (06, 2004), 436, http://search.ebscohost.com/login.aspx?direct=true&db=pdh&AN=apl-89-3-428&site=ehost-live.

[48] Nicola Persico, Andrew Postlewaite and Dan Silverman, "The Effect of Adolescent Experience on Labor Market Outcomes: The Case of Height," *The Journal of Political Economy* 112, no. 5 (Oct., 2004), 1020, http://www.jstor.org/stable/3555270.

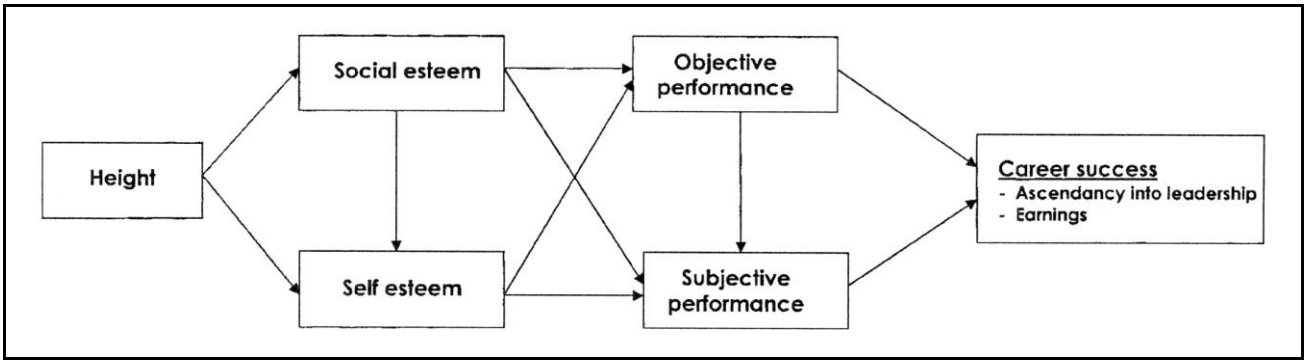
[49] Judge and Cable, *The Effect of Physical Height on Workplace Success and Income: Preliminary Test of a Theoretical Model*, 428.

[50] Ibid., 438

Interestingly, ". . . height seems to predict how observers perceive and evaluate others more than it predicts actual performance."[51]

> Figure [3.1] displays the hypothesized model that links height and career success. Consistent with past research, we conceptualize career success as the outcomes or achievements one has accumulated as a result of one's work, measured by earnings (i.e., compensation) and ascendancy into leadership. . . . In general, the model suggests that height affects career success through several mediating processes. First, height affects how individuals regard themselves (self-esteem) and how individuals are regarded by others (social esteem). Next, social esteem and self-esteem affect individuals' job performance as well as how supervisors evaluate their job performance, which in turn affects success in their careers.[52]

Figure 3.1: Theoretical model of the height-career success relationship



Source: Judge and Cable, *The Effect of Physical Height on Workplace Success and Income: Preliminary Test of a Theoretical Model*, 428.

[51] Ibid., 438

[52] Ibid., 429

Genetics and Environmental Influences

Human final height is dependent upon a combination of genetic, biochemical and hormonal factors which occurs in the teenage years, the early stage of life as an infant and even sooner, in the womb of a mother. Those last factors are also the direct results of the behaviour and resources of the society and family a child is part of.[53] The height of an individual is therefore the result of both the genetic and environmental influences during the growth period.[54] Using an example, it can be understood that:

> Such interaction may be complex. Two genotypes which produce the same adult height under optimal environmental circumstances may produce different heights under circumstances of privation. Thus two children who would be the same height in a well-off community may not only be smaller under poor economic conditions, but one may be significantly smaller than the other . . . . If a particular environmental stimulus is lacking at a time when it is essential for the child (times known as "sensitive periods") then the child's development may be shunted as it were, from one line to another.[55]

This is why although genetic is an important determinant of individual height, environmental factors are considered to play an even larger role. "Studies of genetically similar

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[53] T. Paul Schultz, "Wage Gains Associated with Height as a Form of Health Human Capital," *The American Economic Review* 92, no. 2, Papers and Proceedings of the One Hundred Fourteenth Annual Meeting of the American Economic Association (May, 2002), 349, http://www.jstor.org/stable/3083430.

[54] Richard H. Steckel, "Stature and the Standard of Living," *Journal of Economic Literature* 33, no. 4 (Dec., 1995), 1910, http://www.jstor.org/stable/2729317.

[55] Phyllis B. Eveleth and James M. Tanner, "Worlwide Variation in Human Growth 2nd Edition," (1990), 222.

and dissimilar populations under various environmental conditions suggest that differences in average height across most populations are largely attributable to environmental factors."[56] "Height at a particular age reflects an individual's history of *net* nutrition. The body devotes a substantial share of food to maintenance, and work or physical activity and disease make other claims on the diet."[57] An example of that is that the children of Africans or Europeans who "migrated" to the United States were taller on average than the population of their parents' country of origin.[58] This is why a physical characteristic such as height (at given ages, final one, rate of change, etc.) is now widely used by the World Health Organization and other agencies to assess the nutritional status of the populations of underdeveloped nations.[59]

In 2002, Paul Schultz from the Yale University Department of Economics isolated different statistical groups using different factors to better comprehend the variation of height versus economic outcomes.[60] He used four different instrumental variables such as the environmental conditions and availability of infrastructure and health-related services, the educational attainment of the mother and father as a proxy for family income, a combination of the previous two factors and, finally, information permitting the distinction of the different ethnic groups. Schultz found out that adult height was significantly associated with income in the three countries he obtained data for. In Ghana, each additional centimetre of height was significantly

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[56] Steckel, *Stature and the Standard of Living*, 1910.

[57] Ibid., 1910

[58] Ibid., 1910

[59] Robert W. Fogel, Stanley L. Engerman and James Trussell, "Exploring the Uses of Data on Height: The Analysis of Long-Term Trends in Nutrition, Labor Welfare, and Labor Productivity," *Social Science History* 6, no. 4, Trends in Nutrition, Labor, Welfare, and Labor Productivity (Autumn, 1982), 404, http://www.jstor.org/stable/1170970.

[60] Schultz, *Wage Gains Associated with Height as a Form of Health Human Capital*, 349-353.

associated with a 1.5% increase of wage versus 1.7% for women. In Brazil, the corresponding increase was similar with 1.4% for men and 1.7% for women. As for the United States, the percentages of increase were lower with 0.45% and 0.31% respectively. Interestingly, the mean height of men in the United States is 9-10 cm taller than the height of men of Ghana or Brazil (5-7 cm for women) while the present rate of the average height increase was much faster in those last two countries. Schultz then hypothesized that the lower height/wages ratio in the United States could be due to diminishing returns to nutrition/health associated with height. This is based on the fact that ". . . once income is sufficient to satisfy caloric requirements, only modest increases are attainable through change in the diet."[61] Additionally, he found out that after removing the effect of health resources availability and associated environment as well as education, that the ethnic/race group estimates of height's effect on wages were not significantly different from zero in the United States while it was so in both Ghana and Brazil. In other words, the origin (race or ethnic group) of an individual in the United States is not a factor affecting the height to income relationship.

Although correlated to genetics, stature is also used extensively in the fields of economic history and economic development as a measure of a society's "health" and richness distribution. In his article, *Stature and the Standard of Living*, Richard Steckel from the Ohio State University, demonstrated that ". . . average height in the past century is sensitive not only to the level of income but to the distribution of income and the consumption of basic necessities by the poor."[62] To further demonstrate this last point, Steckel wondered why Americans were taller

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[61] Steckel, *Stature and the Standard of Living*, 1911.

[62] Ibid., 1903

than Europeans in the 18th century and he pointed out some very likely explanations such as good diet, access to better land and resources as well as a low incidence of epidemic disease.

The same ideas as the previous paragraph can also be used to explain the difference in height between socio-economic groups inside the same country. "In eighteenth century Germany, for example, children of aristocrats were 8 to 10 centimetres taller than children of the lower classes, an advantage that closed somewhat as adults."[63] Similarly, in England, at the end of the eighteenth century, the difference between the cadets (mostly well-fed and from aristocratic origin) entering the Sandhurst Military Academy versus the teenagers working in the London factories was an astounding 20 centimeters for the same age group.[64] At almost the same period, "West Point cadets from middle-class families were only 1.1 centimetres taller than those whose fathers had blue-collar occupations."[65] A more uniform wealth distribution or higher base level of wealth in the United States during that period would explain this narrower gap.

Stature, Intelligence and Skills

Like the examples shown in the previous section, many studies have shown that persons from higher socio-economic groups were on average taller than persons from lower socio-economical groups.[66] One of those studies specifically looked at the education level versus

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[63] Ibid., 1922

[64] John Komlos, "Height and Social Status in Eighteenth-Century Germany," *Journal of Interdisciplinary History* 20, no. 4 (Spring, 1990), 610, http://www.jstor.org/stable/204001.

[65] Ibid., 610

[66] A. E. J. M. Cavelaars and others, "Persistent Variations in Average Height between Countries and between Socio-Economic Groups: An Overview of 10 European Countries," *Annals of Human Biology* 27, no. 4 (07, 2000), 408, http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=3825140&site=ehost-live.

height in many European countries. Using only two broad educational groups to classify the individuals, the study in question looked at surveys done between 1987 and 1994 for ten European countries. What was found is that ". . . in all 10 countries, lower educated men and women were on average shorter than higher educated men and women. Among men the differences in average height between the two broad educational groups ranged from 1.6 to 3.0 cm"[67] It is to be noted that the lowest part of the 95% confidence interval was 0.7 cm while it was 3.7 cm for the highest part. Looking at the age of the individuals the study also separated the group in two cohorts (young and old) in order to confirm any trends with regard to the democratization or not of the education and height relationship. What was found is that "Among men, in all countries except the Netherlands, the estimates are negative, implying that height differences by educational level generally were smaller among younger birth cohorts than among older birth cohorts."[68] However, this decrease or "democratization" of the men's education-height relationship was very small and not statistically different in any of the considered countries while there was no change for the women.

As to the why of such a link between the height and the attained education level, the study offers the following explanation: educational level is highly correlated with social class of origin and social class of origin determines childhood living conditions, which affect growth.[69] In addition, "Since tallness is partly determined genetically, and taller persons have a higher

[67] Ibid., 412

[68] Ibid., 413

[69] Ibid., 417

likelihood of being upwardly mobile, an accumulation over successive generations of tallness-related genes cannot be excluded."[70]

Research on stature and success in the United States existed a long time ago, most appropriately with the leadership school of traits. E. B. Gowin did such a research in 1915 when he presented the results of surveys documenting the statistical difference between the heights of executives and labourers.[71] Using the heights of persons of different status internal to a profession, Gowin found out that bishops were on average taller than small town priests and that sales managers were again taller on average than salesmen. Similar findings have also been found and correlated using US data from the National Health Interview Survey (NHIS) and British data from the 1970 British Cohort Survey (BCS); following is a description of Figure 3.2 which uses those data:

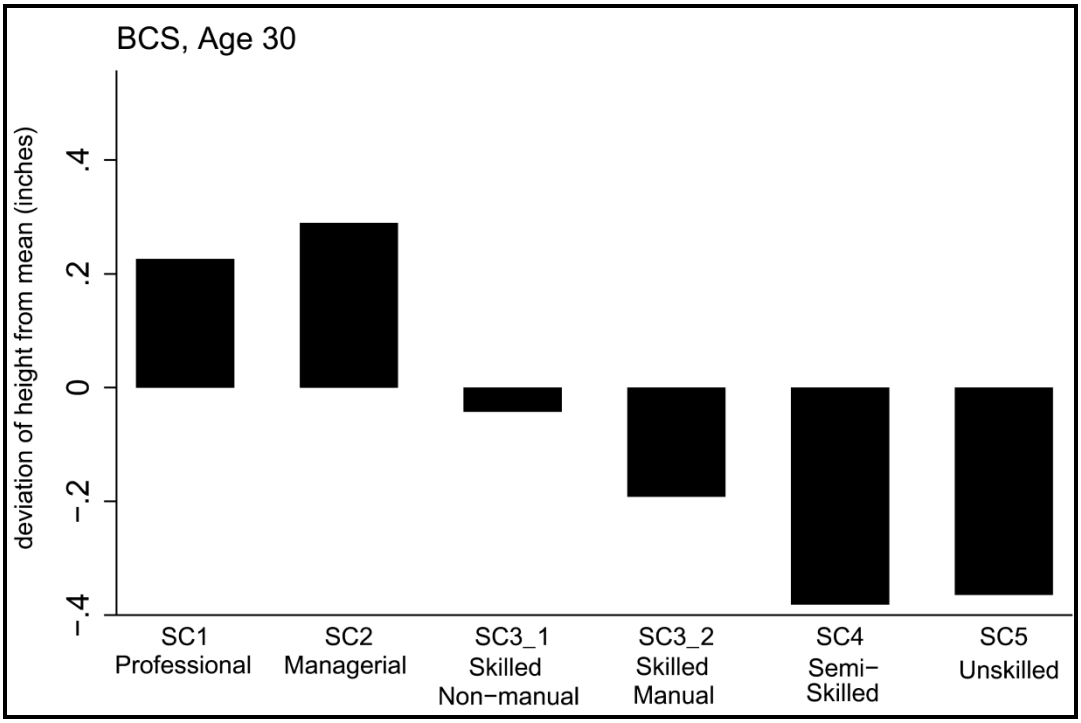
> Height continues to be highly correlated with labor market success in developed countries. Figure 1 [Figure 3.2] provides evidence from the United States and the United Kingdom that more highly skilled jobs attract taller workers. American men in white-collar occupations are an inch taller, on average, than men in blue-collar occupations. Among 30-year-old men in the United Kingdom, those working in professional and managerial occupations are 0.6 inch taller in average than those in manual occupations. Results for women are quite similar: in the United Kingdom, women working as

[70] Ibid., 417

[71] Gowin, E. B., *The Executive and his Control of Men* (Macmillan, 1915), 32

professionals and managers are an inch taller on average than those in manual unskilled occupations.[72]

Figure 3.2: Heights across occupations, men.



Source: Case and Paxson, "Stature and Status: Height, Ability, and Labor Market Outcomes," *Journal of Political Economy* 116, no. 3 (06, 2008), 501.

The above figure and associated description from the Anna Case and Christina Paxson study (Princeton University) are also saying that taller workers are channelled toward white-collar or highly-skilled type jobs. One implied possibility is that highly-skilled jobs require a higher form of intelligence and although the mechanism which underlies the height-intelligence relationship is not well understood, many studies have demonstrated such positive association.[73]

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[72] Anne Case and Christina Paxson, "Stature and Status: Height, Ability, and Labor Market Outcomes," *Journal of Political Economy* 116, no. 3 (06, 2008), 500, http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=33294420&site=ehost-live.

[73] Ibid., 506

One such mentioned recent study used cross-trait cross-twin correlation and concluded ". . . that the environment plays a large role and is responsible for 65 percent of the height-intelligence correlation, with genes responsible for 35 percent of the observed correlation."[74]

Another research paper by Timothy Judge (University of Florida) and Daniel Cable (University of North Carolina) looked at the occupations versus height association. Their assumption was that ". . . the effect of height on earnings should be greater in occupations where stature and respect of others matter more."[75] To confirm this assumption, they looked at the correlation of height versus income within many occupational categories. Table 3.1 is the outcome of their analysis and other than the blue collar category having a slightly higher correlation than the professional-technical category, the general results are consistent with the expectation of a higher correlation between height and earnings for the occupation which may rely on stature and appearance as a means to achieve success.

[74] Ibid., 507

[75] Judge and Cable, *The Effect of Physical Height on Workplace Success and Income: Preliminary Test of a Theoretical Model*, 436.

Table 3.1: Height income Correlations by Occupation

Occupation	*r*	*n*
Sales	.41	117
Managers	.35	455
Blue collar	.32	349
Services workers	.31	265
Professional-technical	.30	453
Clerical	.25	358
Crafts, forepersons	.24	250
Other	.33	3,196
Overall	.33	5,509
Note: The overall sample size does not equal the sum of the rest of the occupational sample sizes because occupational groups with small numbers of individuals (farmers and armes forces, n<10) were excluded. All *r* are for $p < .01$, two tailed.		

Source: Judge and Cable, *The Effect of Physical Height on Workplace Success and Income: Preliminary Test of a Theoretical Model*, 437

On the intelligence side and using two British studies (the 1958 National Child Development Study and the 1970 British cohort study), Case and Paxson were able to show a large and positive correlation between the heights of the children and the scores of their cognitive tests.[76] Another study made by Tuvemo, Jonsson and Persson (Upspsala University, Sweden) looked at the intellectual performance of more than thirty thousand 18 year-old Swedish military recruits subjected to conscription procedures and tests. They found out that the intellectual performance of the recruits was positively correlated with height ($r = 0.14$, $p<0.001$).[77] The intellectual performance was ". . . measured in a standardized, self-administered and computerized test, and therefore unbiased . . ."[78] Using 'standard nine' (stanine) scores, a single-digit standard scores (1-9) based on a normal distribution with a mean of five and a

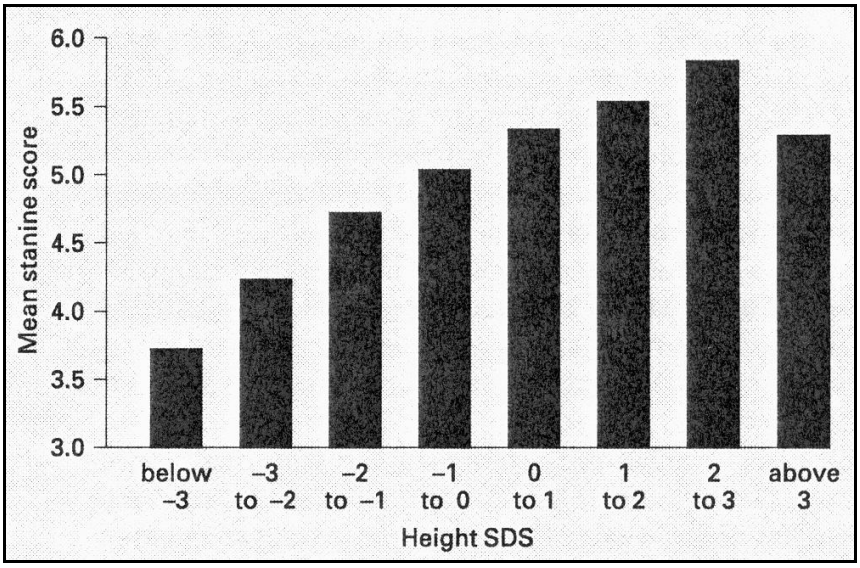
[76] Case and Paxson, *Stature and Status: Height, Ability, and Labor Market Outcomes*, 516.

[77] Torsten Tuvemo, Björn Jonsson and Ingemar Persson, "Intellectual and Physical Performance and Morbidity in Relation to Height in a Cohort of 18-Year-Old Swedish Conscripts," *Hormone Research* 52, no. 4 (10, 1999), 188, http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=11342696&site=ehost-live.

[78] Ibid., 190

standard deviation of two, Tuvemo, Jonsson and Persson created a graph displaying the intellectual performance score of the Swedish recruits in relation to the height standard deviation (Figure 3.3). The figure shows that the highest intellectual scores are obtained by individuals for whom the height is between the second and third standard deviation above the average height of the group and that there is constant negative slope with the standard deviation height diminution.

Figure 3.3: Swedish conscript cohort intellectual performance versus height standard deviation



Source : Tuvemo, Jonnson and Persson, "Intellectual and Physical Performance and Morbidity in Relation to Height in a Cohort of 18-Year-Old Swedish Conscripts" *Hormone Research 52*, 1999, 189

A recent research paper by Alok Kumar (University of Texas at Austin) and George Korniotis (Board of Governors of the Federal Reserve System) found that an individual's height was likely to be an important variable with regard to stock market decisions. They also found that taller investors were more likely to invest their assets into riskier venues such as stock

markets compared to short investors.[79] Kumar and Korniotis also took into consideration many personality attributes correlated with height and still found that height was associated with riskier financial habits (no judgement was made on the outcome of those habits). They concluded that this could well be due to the unobservable effects of positive lifelong experiences and similarly to other studies, found that those positive effects were weaker for women and that it was reversed for very tall individuals.[80]

All of the above therefore shows that stature is positively correlated with cognitive functions, better education and better jobs along with riskier financial habits. It does not however provide a definitive answer as to the why or the origins of those observations.

Leadership Perception and Height

In the article "Nature and Nurture in Leadership", the author Joseph S. Nye (former Dean of the Harvard Kennedy University) wrote "How often have you heard someone say that a political candidate looks (or does not look) like a leader? A tall handsome persons enters a room, draws attention, and "looks like a leader.""[81] The following will look at the origin of such association.

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[79] George korniotis and Alok Kumar, "Tall Versus Short: Height, Lifelong Experiences, and Portfolio Choice" University of Texas at Austin), 13, http://www.mccombs.utexas.edu/news/Kumar_Height.pdf (accessed 23 February 2010).

[80] Ibid.1

[81] Joseph S. Nye, "Nature and Nurture in Leadership," *The Harvard Crimson* (2009), http://www.thecrimson.com/article/2009/6/3/nature-and-nurture-in-leadership-as/

In the English language, there are about 17,000 words naming different characteristics or traits used to identify differences among people.[82] Although leadership is not one of those traits, the leadership school of traits viewed it in the following terms:

> On the contrary, leadership was viewed as an abstract property the existence of which was explainable in terms of other more basic or fundamentals traits distinguishing individuals. In this sense leadership was treated as a *second-level trait construct* composed of, or highly related to, more fundamental *first-level trait constructs* that included physical and constitutional factors, skills and abilities, personality characteristics and social characteristics. . . . Presumably the more qualities or attributes contained in the list a person possesses, the more he or she is likely to be an effective leader.[83]

The above quotation from a paper by Arthur G. Jago (University of Missouri) about leadership traits is used as a lead-in to the attribution theory of leadership presented in the same paper and which should be considered as synonymous to the information-processing theory introduced in the last chapter. "People label others as possessing or as not possessing leadership qualities and the manner in which those labels become attached is the foundation of an attribution theory of leadership."[84]

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[82] Arthur G. Jago, "Leadership: Perspectives in Theory and Research," *Management Science* 28, no. 3 (Mar., 1982), 317, http://www.jstor.org/stable/2630884.

[83] Ibid., 317

[84] Ibid., 318

The height advantage is one of those characteristics or traits very often used as one belonging to the idea of leadership. Both the Jago[85] and the Barrow[86] papers are examples of this. Knowing that the ". . . process by which people infer that real or imagined leadership qualities exists in others is important . . ."[87] and that stature is very often used as a physical trait to make such an inference, one should therefore not be surprised at the importance, rightly or not, of the height factor for our politicians and business executives along with anyone else who wants to "look like a leader".

An organizational behaviour professor at the Stanford University graduate school of business, Lara Tiedens, stated that ". . . people of status often use height, or an inflated appearance of height , to look more powerful."[88] Malcom Gladwell, the author of the best-seller *Blink: The Power of Thinking Without Thinking* reports that 30% of the Fortune 500 CEOs are taller than 74 inches (6 feet 2 inches) compared to 4% for the US male population.[89] This means that compared to the general population, tall persons are over-represented by a factor of more than seven. In a non-scientific survey made in 2008 by the USA Today, active and retired CEOs along with leading executives were asked whether, if given a choice, they would rather be bald than short.[90] The answers were almost unanimous as 95 % of the 74 received answers, chose

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[85] Ibid., 317

[86] Barrow, *The Variables of Leadership: A Review and Conceptual Framework*, 232.

[87] Jago, *Leadership: Perspectives in Theory and Research*, 318.

[88] Del Jones, "Does Height Equal Power? some CEOs Say Yes," *USA Today* (, http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=J0E390464375907&site=ehost-live.

[89] Malcom Gladwell, *Blink: The Power of Thinking without Thinking* (New-York, USA: Back Bay Books/Little, Brown and Company, Hachette Book Group, 2005), 86-87.

[90] Del Jones, "The Bald Truth about CEOs," *USA Today* (, http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=J0E389338341008&site=ehost-live.

baldness over shortness as being vertically challenged was considered to be more detrimental to an aspiring executive's career.

Interestingly, height might not be the only characteristic that is often associated with positive leadership through association or perception. In the last few years, the charismatic leader has been widely discussed and analyzed as part of the transformational leadership school. And like the traits school, it is also contentious as a study written by Bardley R. Agle (University of Pittsburgh) and titled "Does CEO Charisma Matter?" demonstrates:

> . . . our evidence suggests that CEOs who are perceived to be more charismatic appear to be perceived as more effective. In this subjective sense, CEOs matter. However, the lack of corroborating evidence from objectively-assessed CEO performance suggests that the search for charismatic CEOs may be based more on implicit theory or halo effects than on solid evidence that charisma really does make CEOs more effective.[91]

Interestingly, what the study in question also found is that ". . . organizational performance is associated with subsequent perceptions of CEO charisma, but that perceptions of CEO charisma are not associated with subsequent organizational performance, even after incorporating the potential moderating effect of environmental uncertainty."[92] This is a classic mixed-up of cause and symptom. The meaning of this is that when the performance of an organization increases, so does the perception of its CEO charisma. As for the opposite relation,

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[91] Agle and others, *Does CEO Charisma Matter? an Empirical Analysis of the Relationships among Organizational Peformance, Environmental Uncertainty, and Top Management Team Perceptions of CEO Charisma*, 19.

[92] Ibid., 2

where there is an increase in charisma at the CEO level (newly hired for example), there is no subsequent correlated increase in organizational performance.

The relation between charismatic CEOs (or leaders) and height is that both traits or characteristics are perceived through the halo effect of what should be a leader. They are traits that might wrongly be associated with efficient leadership, even though it might be at the unconscious level. This is not new. a 1935 article by David P. Page in the American Journal of Sociology on measurement and predictions of leadership looked at the performance and traits of West Point cadets. One of the most interesting conclusions follows:

> More surprising was the evidence of the very slight relationship between leadership and height. Not only does the more casual literature on leadership give some basis for expecting a fairly high degree of correlation here, but several studies sustain the popular opinion that leaders are, in general, above the average [height], at least of their followers.[93]

The interpretation of the above is that in a very controlled and defined environment and against its own expectations (and those of many others at that time), Page only found a very small correlation between height and leadership. Studies like this one were likely the first cracks that appeared on the foundation of the traits school associated with that period. However and as stated by Nye:

> The traits-centered approach has not vanished from modern studies of leadership but it has been broadened and made more flexible. Traits have come to be seen as consistent

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[93] David P. Page, "Measurement and Prediction of Leadership," *The American Journal of Sociology* 41, no. 1 (Jul., 1935), 36, http://www.jstor.org/stable/2768178.

patterns of personality rather than inherited characteristics. This definition mixes nature and nurture, and means that "traits" can, to some extent, be learned rather than merely be inherited.[94]

The above about leadership nature and nurture goes well with the personal theory of someone like 5ft 6 inches Harold Burson, chairman and co-founder of one of the largest public relations firm in the world. Burson stated that short CEOs rise from within the company while executive search firms are more likely to produce the above average height outsiders.[95]

To summarize, Stature has often be used as a physical trait associated with leadership. Because of the halo effect and the information-processed school which view height as a positive characteristic, height like charisma, is sometimes rewarded as can be seen by the out of proportion percentage of tall persons among CEOs and the continuous search for charismatic leaders. Unfortunately, it is not any better in the political domain.

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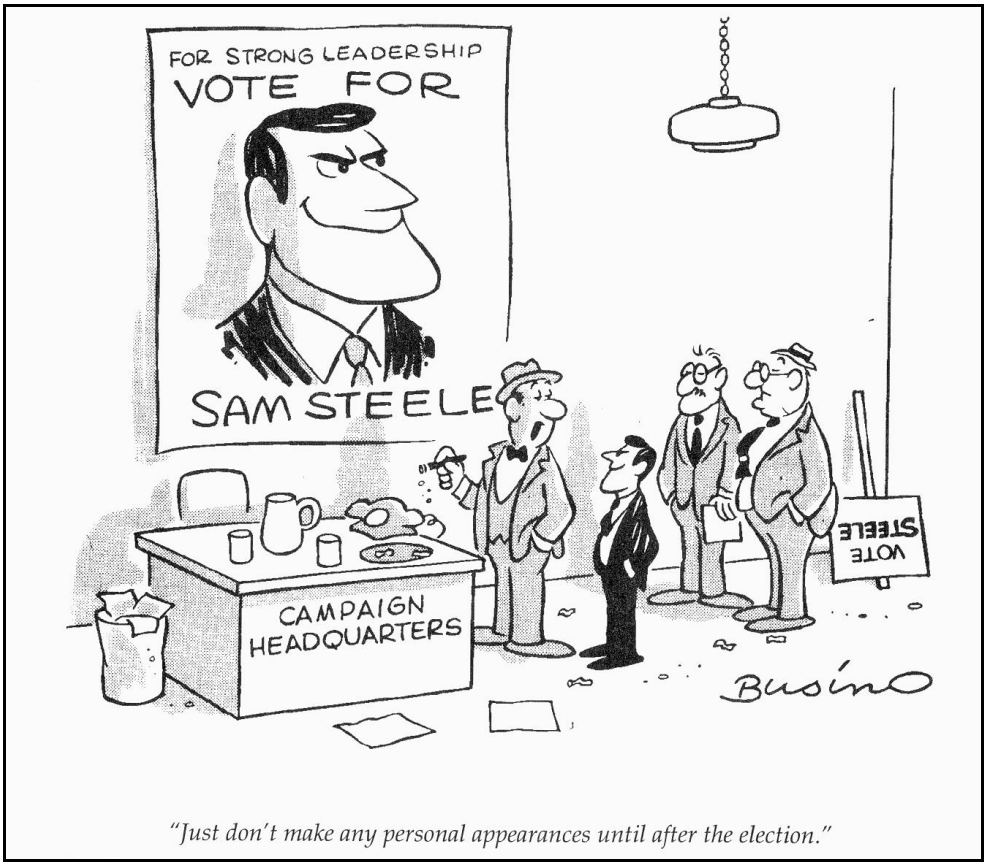
[94] Nye, *Nature and Nurture in Leadership*, 23 February 2010.

[95] Jones, *Does Height Equal Power? some CEOs Say Yes*

Politics and Height

Figure 3.4 : Saturday Evening Post Society Comic



Source: Hugues, Ginett and Curphy, *Leadership: Enhancing the Lessons of Experience*, 1996, 36

In politics, to say that public image is important would be an understatement. In today's world, almost every Chief-of-State, or those aspiring to become one, have on their staff a public affairs or communications officer in order to face the modern media and, indirectly, the potential voters. Both the political message and how it "looks" to the audience is important. Although the above figure (3.4) is for comic purpose, it may also, unfortunately, be a representation of the reality. The following will briefly look at some aspects of how our modern societies and politicians as leaders are affected by their stature.

On 8 September 2009, French President Sarkozy, while visiting a factory in Northern France, addressed the factory employees and pictures of him with representatives of the company in the background were taken. Although officially denied by the President's Office, it was later found out that all employees in the background were selected so that President Sarkozy would look taller in comparison. The French President's height is reported at 5ft 5in or 5ft 6in and his height is often mocked by the media.[96] Using another French President to provide a contrasting view, one can look at Charles de Gaulle who was 6ft 5in.[97] In fact, in his book *Leaders* published in 1982, Richard Nixon commented on De Gaulle by observing that "His tall stature and imperious manner conveyed the message he was not a common man."[98]

In North America, the heights of US Presidents and presidential candidates have also been subjected to some level of scrutiny.[99] Although not necessarily a viable statistic, it has been found out that in the history of the United Sates, the taller of the two presidential candidates won 53% of the time compared to 39% for the shortest (8% of the time they were of the same height). However, if arbitrarily using 1900 as the starting date, the previous percentage becomes 73% for the tallest candidates becoming President (19 out of 26, excluding tied heights). One possible explanation could be the increasing importance of the physical image due to the ever increasing media expansion (mostly newspapers and TV). Figure 3.5 is a graph showing the heights of all

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[96] "Sarkozy Height Row Grips France," *BBC News*, http://news.bbc.co.uk/2/hi/europe/8243486.stm

[97] Internet Movie Database, "Bioghraphy for Charles De Gaulle," IMDB, http://www.imdb.com/name/nm0208540/bio24 February 2010).

[98] Richard L. Hugues, Robert C. Ginnett and Gordon J. Curphy, *Leadership: Enhancing the Lessons of Experience*, Second Edition ed. (USA: Irwin McGraw-Hill, 1996), 23.

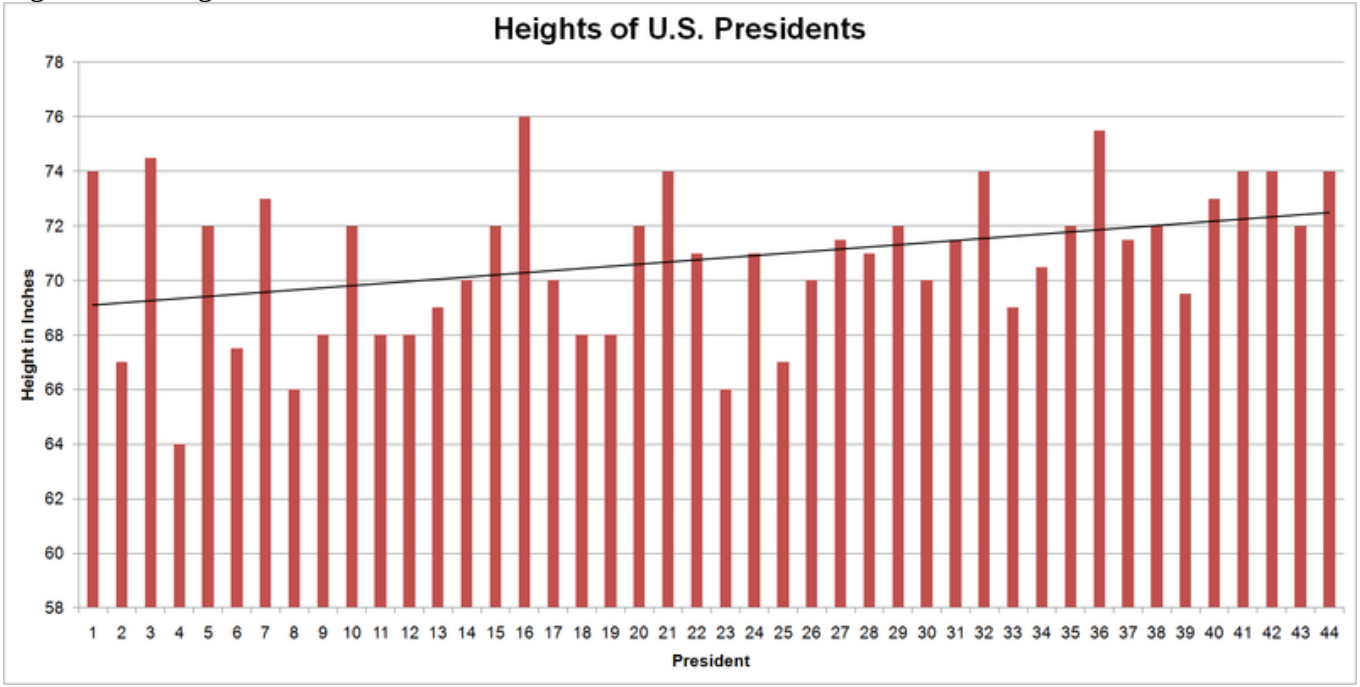
[99] Wikipedia, "Heights of United States Presidents and Presidential Candidates," Wikipedia, http://en.wikipedia.org/wiki/Heights_of_United_States_Presidents_and_presidential_candidates23 February 2010).

the American Presidents along with the least-squared linear line. Of particular interest is the fact that the present average height of the American men is 69.4 inches (data gathered in 2003-2006).[100] Knowing that, one can notice that the last time that a US President was smaller than today's average male height was in 1900 (President #25, William McKinley was 67 inches). Looking further in the United States history, the average height for the (white) men oscillated between 67 and 68 inches for those born between 1720 and 1920 and it is only after that period that the US average height went above the 68 inches barrier.[101] This means that since the creation of the United States, only 6 President (or 14%) were below the average height of the population at the time of their election. This also means that excepted for Benjamin Harisson (66 inches) in 1888, no other US president have been smaller than the US average population in the last 174 years (President #8, Martin Van Buren was 66 inches). Figure 3.6 shows the Height of the US president versus the population (men) average height.

[100] Margaret A. McDowell and others, "Anthropometric Reference Data for Children and Adults: United States, 2003-2006," *National Health Statistics Reports*, no. 10 (22 October 2008), 16, http://www.cdc.gov/nchs/data/nhsr/nhsr010.pdf (accessed 24 February 2010).

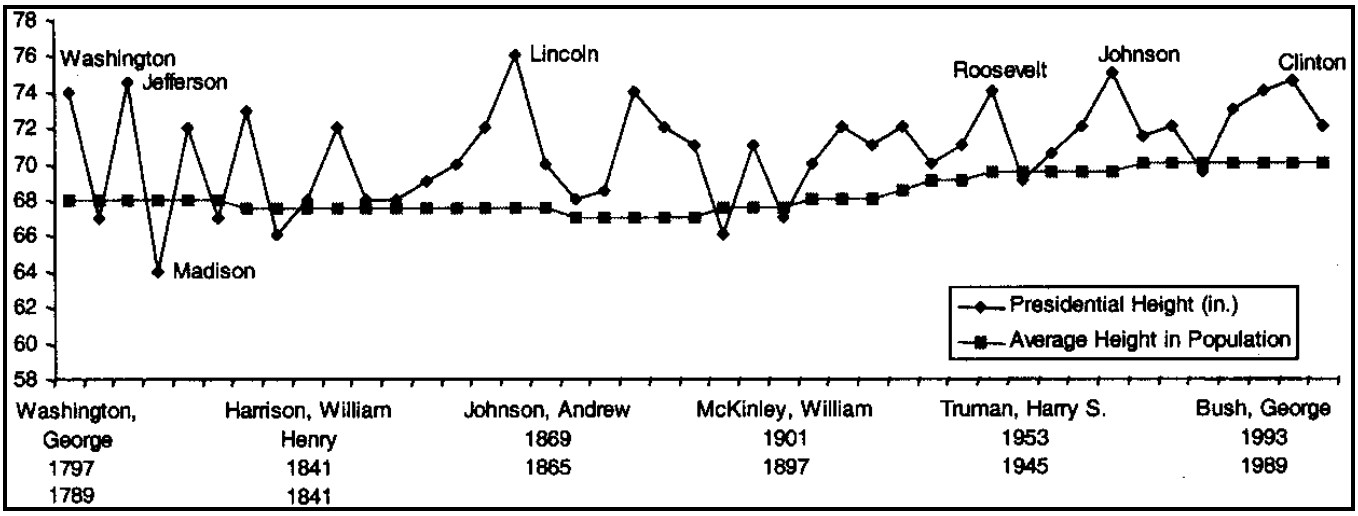
[101] Steckel, *Stature and the Standard of Living*, 1918.

Figure 3.5: Heights of US Presidents from Lincoln to Obama



Source: Wikipedia, *Heights of the United States Presidents and Presidential Candidates*.

Figure 3.6: Comparison of US Presidents versus average height of US Males



Source : Persico, Postlewaite, and Silverman, *The Effect of Adolescent Experience on Labor Market Outcomes: The Case of Height*, 1021.

The above might explain why some of the US politicians' communications officers would say some "white lies" about the height of their candidates. Republican candidate Rudy

Giuliani campaign has reported him to be 72 inches (6 feet) but this was contradicted by other independent sources which stated his height is actually slightly less than 70 inches. The same occurred with the Republican Presidential candidate, John McCain, whose campaign reported him at 69 inches versus the actual 67 inches reported by many other sources.[102]

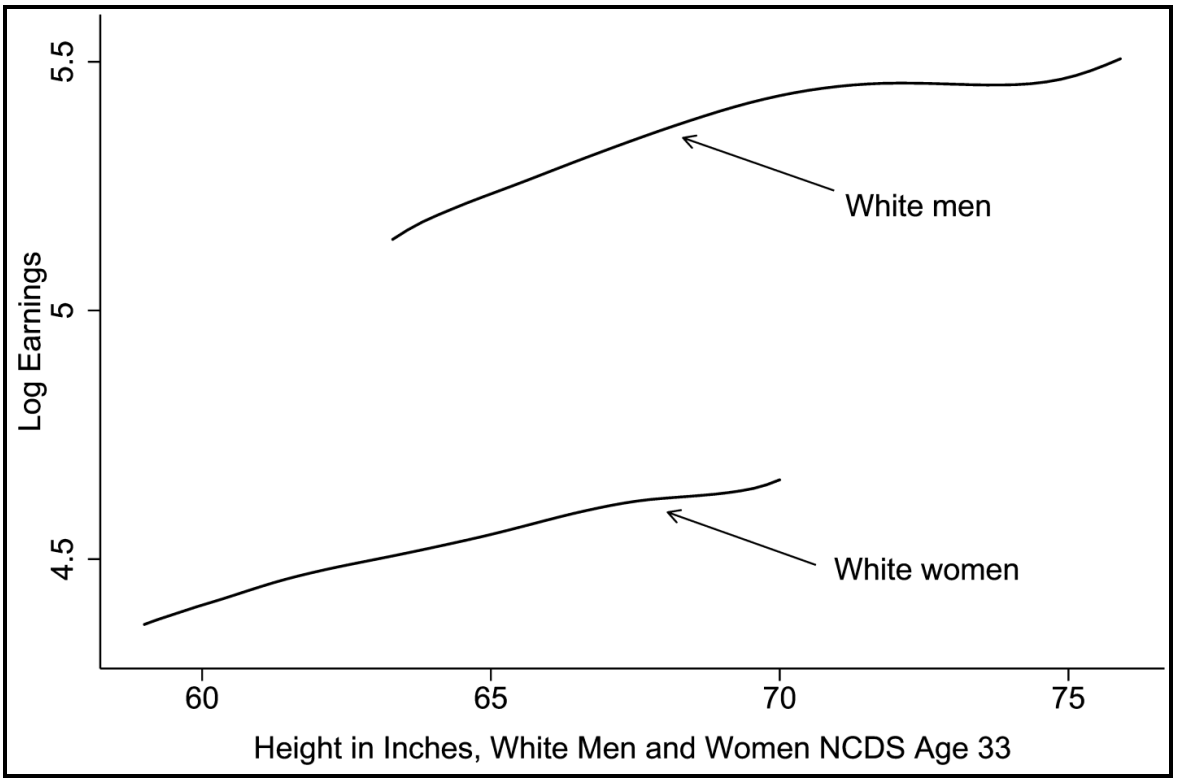
Height and Earnings

Height is highly correlated to labor market success and associated earnings. Using data from the US Panel Study of Income Dynamics (PSID), Case and Paxson found that an increase of 4 inches for a men (going from the 25th to the 75th percentile of height distribution) results in an increase of 9.2 % of income.[103] The following figure (3.7) shows the height increase versus income relationship for both men and women based on the National Child Development Study (NCDS) data and it is easy to see the positive correlation between earnings for both gender.

[102] Peter Baker, "Head and Shoulders Above the Rest," *The Washington Post*11 October 2007, 2007, http://blog.washingtonpost.com/44/2007/10/11/head_and_shoulders_above.html (accessed 23 February 2010).

[103] Case and Paxson, *Stature and Status: Height, Ability, and Labor Market Outcomes*, 500.

Figure 3.7: Log earning and height, men and women



Source: Case and Paxson, *Stature and Status: Height, Ability, and Labor Market Outcomes*, 502.

For Case and Paxson, ". . . the height premium in earnings is largely due to the positive association between height and cognitive ability, and it is cognitive ability rather than height that is rewarded in the labor market."[104] However, another paper by Judge and Cable refutes this argument as a shortcut. Judge and Cable did indeed find a significant correlation between height and intelligence (see also the above section on intelligence and height) but also that the height to earnings relationship did not appeared to be linked to the height to intelligence relationship.[105] In one study, Judge and Cable found that when controlling for intelligence, ". . . the standardized

[104] Ibid., 503

[105] Judge and Cable, *The Effect of Physical Height on Workplace Success and Income: Preliminary Test of a Theoretical Model*, 436.

regression coefficient of height in predicting earnings changed from β = .44 to β =.42 . . .”[106], a very small change indeed. In addition, Judge and Cable, using another study for which the intelligence tests scores were available for some of the participants, found that intelligence had no relationship with height or earnings.[107]

For the height to earnings relationship, Judge and Cable looked at the descriptive statistics and associated correlations of four studies. They found that “height was positively correlated with earnings in all four samples. The height-earnings correlations were relatively consistent, ranging from r = .24 to r = .35 (all ps < .01).”[108] What those numbers actually mean is that “By averaging across these results, we find that an individual who is 72 in. tall could be expected to earn $5,525 more per year than someone who is 65 in. tall, even after controlling for gender, weight, and age.”[109]

Another very interesting paper is one by Persico, Postlewaite and Silverman. Using data from the British NCDS where height was recorded at age 7, 11, 16 and 33 years old, they found out that when controlling for the heights of the individuals (male in those case), only the height at 16 years old mattered with regard to the earning as an adult.[110] Both the pre-teen height as well than the adult height was found to be not statistically significant when controlled while the height reached at 16 years-old was definitely significant. It is to be noted that even though

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[106] Ibid., 436

[107] Ibid., 436

[108] Ibid., 435

[109] Ibid., 435

[110] Persico, Postlewaite and Silverman, *The Effect of Adolescent Experience on Labor Market Outcomes: The Case of Height*, 1032.

women were found to also have an economically substantial height premium, the authors did not observed a similar discriminatory pattern for a specific age. The authors also looked at self-esteem and intelligence as a possibility to explain the results but although they detected a correlation between teen self-esteem or intelligence with future earnings, they didn't found that controlling for those had any important effect on the teen height premium.[111] One possible explanation advanced by the authors:

> About half of the wage differential can be accounted for by variation in school-sponsored non-academic activities (such as athletics and clubs) . . . Viewed in this light, our findings suggest that social effects during adolescence, rather than contemporaneous labor market discrimination or correlation with productive attributes, may be at the root of the disparity in wages across heights.[112]

Finally, one of the most recent papers on the height premium is from Case, Paxson and Islam. Using nine waves of panel data from the British Household Panel Survey (BHPS), they found, after controlling for age and race, ". . . that each inch of height is associated with a 1.5 to a 1.8 percent increase in wages for both men and women."[113]. They also nuanced their previous explanations about the possible origin of the height premium as per the following:

> . . . there is a positive and significant association between height and cognitive function during childhood. Moreover, the height premium observed for these cohorts in adulthood

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[111] Ibid., 1041

[112] Ibid., 1024

[113] Anne Case, Christina Paxson and Mahnaz Islam, "Making Sense of the Labor Market Height Premium: Evidence from the British Household Panel Survey," *Economics Letters* 102, no. 3 (March 2009, 2009), 174.

largely disappears when test scores from childhood – a proxy for cognitive ability in adulthood - are added as controls.[114]

This section has shown that although the actual origin or possible explanations of why there is such a thing as a height premium on earnings, there is no dispute that such things exist and that the effect is more evident for men than for women. There seems to also be a convergence of opinions about the fact that the origin of the adult height premium on earning might be somewhere between the child and teen period.

Other Physical Factors and Earnings

Because every individual has a society conditioned pre-conceived idea of what a leader looks like, there are many other variables or traits that are, wrongly or not, also associated with leadership as per the school of information processing. Both weight and beauty will be briefly examined and although leadership is not actually measured, income as the most likely proxy candidate will be used for comparisons purposes.

Looking first at weight, it is tempting to sort an overweight person into the non-leadership category or one that is having a lower income. However, the situation is not that clear. Using data from 1973, McLean and Moon published a paper in 1980 about the impact of weight on wages for 2,356 men between the ages of 51 and 65. Contrary to what they were expecting, they found a small but positive effect of obesity on earnings.[115] To the contrary,

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[114] Ibid., 174

[115] Robert A. McLean and Marilyn Moon, "Health, Obesity, and Earnings," *American Journal of Public Health* 70, no. 9 (09, 1980), 1009, http://search.ebscohost.com/login.aspx?direct=true&db=heh&AN=4958448&site=ehost-live.

another study published in 1995 by Averett and Korenman found ". . . some evidence of wage penalties associated with both underweight and obesity among men."[116] Although, they do not arrive to the same conclusion, both studies certainly show that weight does not seem to be an important factor for wages. However, this conclusion might be different if one is to look at a military population where physical fitness is not-only encouraged but where strongly overweight individual are likely to be released.

As for the beauty factor with regard to income (beauty not being related to actual work results), Biddle and Hamermesh found that having a below-average looks penalized the men by 9% versus 5% for women while the premium for above-average looks was 5% and 4% for men and women respectively.[117] The interesting part about the previous number is that contrary to the popular expectation (which differs from the facts in that case),[118] the delta for the beauty is less for women than for men. The same authors later published another paper based on the income and employers (private versus public) of one school law graduates, 5 and 15 years after graduation. They concluded that a two standard-deviation increase in beauty (based on a finite scale of 1 to 5) resulted in a 10% increase in salary, controlling for the other variables. They also concluded that better-looking attorneys earned more than others 5 years after graduation and that the difference was larger 15 years after graduation. Finally, they observed that the better-looking

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[116] Susan Averett and Sanders Korenman, "The Economic Reality of the Beauty Myth," *Journal of Human Resources* 31, no. 2 (Spring96, 1996), 327, http://search.ebscohost.com/login.aspx?direct=true&db=heh&AN=9605233018&site=ehost-live.

[117] Jeff E. Biddle and Daniel S. Hamermesh, "Beauty, Productivity, and Discrimination: Lawyers' Looks and Lucre," *Journal of Labor Economics* 16, no. 1 (Jan., 1998), 1185, http://www.jstor.org/stable/2535337.

[118] Patricia Roszell, David Kennedy and Edward Grabb, "Physical Attractiveness and Income Attainment among Canadians," *Journal of Psychology* 123, no. 6 (11, 1989), 553, http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=5370744&site=ehost-live.

attorneys were more likely to work in the private sectors while the less attractive were more likely to work for the public sector. Both those beauty outcomes are mostly generated by clients preferring to engage better-looking attorneys, rightly or not.[119]

Another interesting study on Beauty impacting wages is the recent one (2006) by Mobius and Rosenblat. Using workers negotiating their skills by mean of resume (with picture or not), phone interview (with picture or not), or face to face interview, interviewers had to decide the wages of the workers. The first interesting conclusion found (equally for leadership purpose) was that a one standard-deviation increase in beauty raised the confidence of the individual by between 13 and 16%.[120] A second one is that even taking into account this extra-confidence obtained from the beauty factor, workers who were considered beautiful (one standard-deviation) were able to obtain a salary premium of 11% if their picture was presented with their resume, 10% and 9% for the phone interview with and without a photo with the resume, and finally 12% when doing a face-to-face interview.[121] The interesting part here is that although there is as an anticipated premium obtained from the photo in the resume, there is correlation for the premium associated with visual beauty even though no pictures were shown to the interviewers. This means that the interviewers were giving a premium to some individuals based uniquely on oral cues and that those cues are related to physical beauty.[122] The authors believe that beauty helps

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[119] Biddle and Hamermesh, *Beauty, Productivity, and Discrimination: Lawyers' Looks and Lucre*, 172,185,198.

[120] Markus M. Mobius and Tanya S. Rosenblat, "Why Beauty Matters," *The American Economic Review* 96, no. 1 (Mar., 2006), 230, http://www.jstor.org/stable/30034362.

[121] Ibid., 231

[122] Ibid., 234

confidence and that because of it individuals would be more socially active and better at public speaking and that the voice would carry those cues.

A similar study by Wilson and Eckel and published in the same year arrived at similar conclusion while introducing the concept of trust and punishment. Using a trust game in which trust was positively rewarded, Wilson and Eckel found that attractive trustees make more profit at the initial stage of the game as they are considered more trustworthy. In addition, they also observed that beautiful people were likely to receive a harsher penalty when deceiving the other person, likely for not living up to the trust expectation.[123]

The above shows that our society often "judges a book by its cover" and that traits other than height are also used to do so. It was found that contrary to popular opinion weight does not seems to be a criteria affecting men's income. As for the beauty factor, there are many studies showing a positive correlation between salary and beauty and this correlation is larger for men than women. Beauty is also positively correlated to self-confidence.

Conclusion

The above sections have demonstrated many things. First that height, although correlated to genetics is also very strongly correlated to other environmental factors like parents' education, family income and class of origin, and that those factors will influence childhood nutrition and general height. US and European studies also show that height was positively correlated with education and that taller people are more likely to end-up in high-paying jobs. In addition, it was learned that the correlation between earning and job is higher in domains like salesman or

[123] Rick K. Wilson and Catherine C. Eckel, "Judging a Book by its Cover: Beauty and Expectations in the Trust Game," *Political Research Quarterly* 59, no. 2 (Jun., 2006), 189-202, http://www.jstor.org/stable/4148087.

manager where there is more human interaction and where stature and appearance is more important. As for intelligence, many studies show a positive relationship between height and cognitive abilities, although the effect is going down for the extremely tall person (more than 2 standard deviations).

It has been shown that politicians will lie about their heights and that it has been 110 years since a US President was below average height. This could well be due to our societies wrongly using height as an indicator of leadership or performance and that might also be why 30% of the 500 Fortunes CEO are above 6 ft 2in compared to 4% in the society. Similarly, it was also explained that beauty was a positive factor being used for trusting an individual or when negotiating his or her salary. On the earnings side, many studies prove that being tall pays and as such, a combination of many studies came to the conclusion that taller persons were making on average an additional $789 per extra inch.

Although height is positively correlated to earning and intelligence, it was also concluded that when controlling for intelligence, there was a significant height premium, thus debunking the idea that some researchers had that tall people get paid more because they are more intelligent. Additionally, when controlling for height at different ages, one study concluded that it was the height as a teenager (16 years old) that actually mattered in terms of significant correlation with the adult earnings; social interaction and the building-up of human capital being one avenue considered for explaining this peculiarity. Most of the conclusions are gender-equal, although many times, height has less pronounced effect for women.

Case and Paxson wrote that "To the extent that height is a marker of cognitive function, employers might statistically discriminate in favour of taller workers, at least until employers

have time to learn about employees' abilities."[124] They concluded that it would be interesting to follow a cohort in the long term to see whether the height premium eventually disappears. This is what will be done indirectly in the next Chapter.

[124] Case and Paxson, *Stature and Status: Height, Ability, and Labor Market Outcomes*, 529.

CHAPTER 4 – HEIGHT AND THE CANADIAN FORCES

Introduction

The Canadian Forces (CF) is a subset of the Canadian society. As such, it can reasonably be expected to also have a height bias with regard to its leaders, a bias which would be reflected throughout the ranks. Using a relatively large database showing the gender, trade, rank and height for each entry, it will be demonstrated that the promotion system of the CF is actually fairer as a whole than our society (see previous Chapter) as the height bias is not statistically present. In addition and as an exception to the previous statement, it will also be discovered that the entry-level ranks of both officers and NCM are shorter than the subsequent ranks and that selected CWOs are definitely favoured by the height bias.

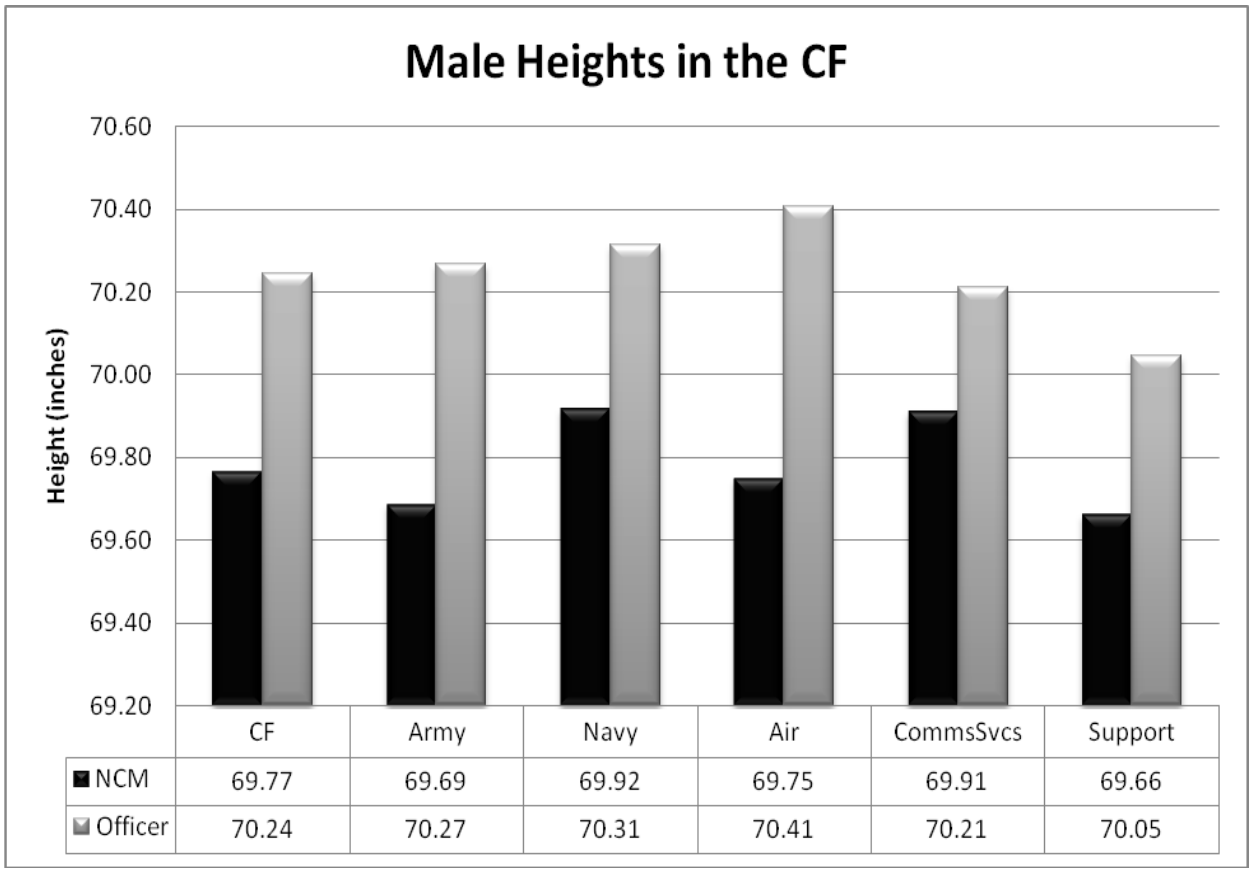
In order not to burden the reader with too many graphs or background information, Annexes A to D were created. Annex A details the CF rank structure as well as the grouping of trades in branch or sub-group. Annex B provides the origin, data manipulation and associated characteristics in order for the reader to have a quasi-complete view of the data used for arriving at the presented conclusions. Annex C is a comparison of the average height of Canadian society with the CF as well as an introduction to the concept of self-reporting bias for height dataset. Finally, Annex D groups some of the female graphs that can either be quickly summarized or are not statistically significant but still needed to be recorded in order to show completeness of work.

Analysis Process and Observations

NCM versus Officers

The fact that Officers are taller than NCM was discovered because the first step taken with the data was to look at the height average for each branch with the gender and belonging to either the officer or the NCM rank structure as discriminators (Figures 4.1 and 4.2). The visual surprise was a finite difference in height between officers and NCM for both genders (with the exception of the female communication & services branch). In order to mathematically confirm the difference, a t-Test assuming unequal variances was performed on the NCM and officers group, and this for both male and female. Tables 4.1 and 4.2 show the outcome.

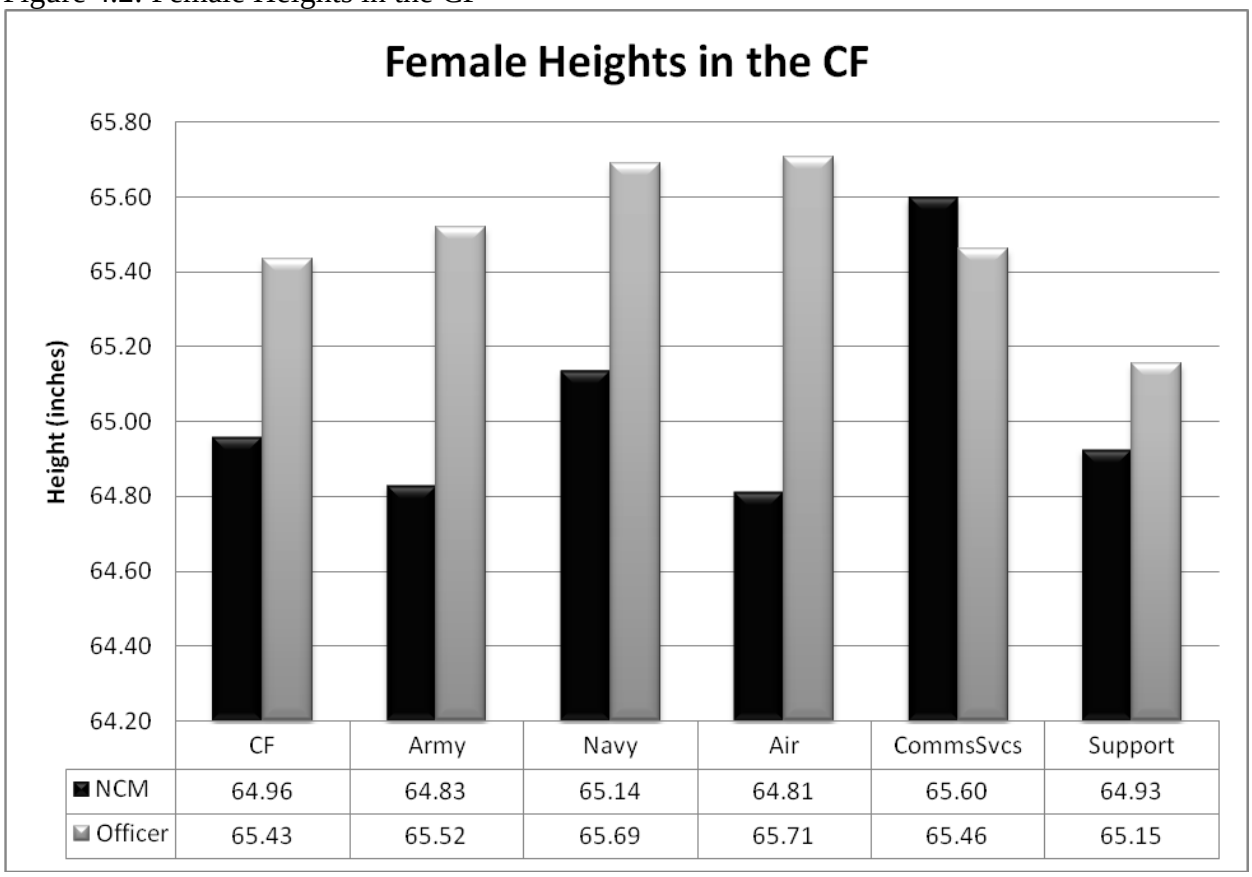
Figure 4.1: Male Heights in the CF



	CF	Army	Navy	Air	CommsSvcs	Support
NCM	69.77	69.69	69.92	69.75	69.91	69.66
Officer	70.24	70.27	70.31	70.41	70.21	70.05

Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure 4.2: Female Heights in the CF



Source: Logistik Unicorps dataset obtained on 28 September 2009

Table 4.1: t-Test on height of male NCM and officers

	NCM	*Officer*
Mean	69.76644	70.24326
Variance	9.720682	9.407639
Observations	23490	7610
Hypothesized Mean Difference	0	
df	13081	
t Stat	-11.7384	
P(T<=t) one-tail	5.84E-32	
t Critical one-tail	1.64497	
P(T<=t) two-tail	1.17E-31	
t Critical two-tail	1.960145	

Source: Logistik Unicorps dataset obtained on 28 September 2009

Table 4.2: t-Test on height of female NCM and officers

	NCM	*Officer*
Mean	64.95892	65.43312
Variance	7.767831	8.278184
Observations	3718	1594
Hypothesized Mean Difference	0	
df	2929	
t Stat	-5.55667	
P(T<=t) one-tail	1.5E-08	
t Critical one-tail	1.645374	
P(T<=t) two-tail	3E-08	
t Critical two-tail	1.960774	

Source: Logistik Unicorps dataset obtained on 28 September 2009

The important values required to draw a conclusion are highlighted in the above tables. Using the two-tail value to be on the safer side (the one-tail value could also be used and is less stringent), it can be seen that the calculated *t* value is higher (in absolute form) than the obtained *t* critical and that the *p* value is lower than 0.05 (to be confident at the 95% level) in both case. This permits us to conclude that the officers are statistically and significantly taller than NCM in the CF and this for both male and female. In fact, the *p* value is so small in both cases, that the certainty of the conclusion could be said to be 100%.

Rank versus Height

It will here be proven that the CF does not have a height bias with regard to promotion (except for the Navy) but that there seems to be a form of filtering between the entry level ranks and the subsequent ones. If one assumes, that like our society, there is a form of positive bias toward taller person in the CF, it would be expected to show up throughout the CF rank structures of either the NCM or the officers (the higher the rank, the taller). This is why the height average of each rank plus or minus the associated standard-deviation is graphically represented for both the NCM and the officers in Figures 4.3 to 4.6. Using the least-square

method, a simple line with a slope was added to each graph; the more positive the slope of the obtained equation, the more difference of height there is between each rank. As for the R^2 shown with each equation, it represents the closeness or fidelity of the equation to the actual graphical data; an R^2 of 1 being a perfect match.

Figures 4.3 and 4.5 are based on their original datasets while Figures 4.4 and 4.6 are based on filtered datasets called NCM(-) or Officers(-), the minus sign representing "minus respective junior ranks". As a result, NCM(-) includes all the ranks of the NCM structure minus the Private while Officers(-) includes all the ranks of the officer structure minus the officer-cadet, second-lieutenant and lieutenant. Those new datasets (-) were created based on the observation that the entrance ranks looked somewhat shorter than the remaining one and that it might impact the subsequent outcomes.[125] This intuition was tested with t-Test comparing the entrance rank from the rest of the ranks structure and this for both male and female. Tables 4.3 to 4.4 prove that for both male NCM and officers, their entrance rank level is statistically shorter than the rest of their respective ranks with practically a 100% certainty. However, the same cannot be said for the females group, Tables 4.5 and 4.6 show that we cannot consider the height of the female NCM entrance rank to be significantly different than the rest of the NCM rank structure and similarly for the officers. This discovery has interesting consequences and in order to correctly interpret them, many of the following analysis will be done in parallel for both the original datasets and those with the junior ranks removed. Because of those datasets (-), Table 4.7 revisits the t-Test of Table 4.1 which proved that the height of male NCM and officers were

[125] Following a discussion with Dr. Okros at the Canadian Forces College, 11 Jan 2010

statistically different but this time with the minus junior ranks new datasets. The result is that although the average height of both groups went up, there are still very significantly different.

Table 4.3: *t*-Test assuming unequal variance for male NCM

	NCM	*NCM(-)*
Mean	69.76644	70.08379
Variance	9.720682	10.26288
Observations	23490	11924
Hypothesized Mean Difference	0	
df	23399	
t Stat	-8.88925	
P(T<=t) one-tail	3.29E-19	
t Critical one-tail	1.644919	
P(T<=t) two-tail	6.59E-19	
t Critical two-tail	1.960065	

Source: Logistik Unicorps dataset obtained on 28 September 2009

Table 4.4: *t*-Test assuming unequal variance for male officers

	Officer	*Officer(-)*
Mean	70.24326	70.53255
Variance	9.407639	8.799141
Observations	7610	4044
Hypothesized Mean Difference	0	
df	8487	
t Stat	-4.95244	
P(T<=t) one-tail	3.74E-07	
t Critical one-tail	1.645033	
P(T<=t) two-tail	7.47E-07	
t Critical two-tail	1.960243	

Source: Logistik Unicorps dataset obtained on 28 September 2009

Table 4.5: *t*-Test assuming unequal variance for female NCM

	NCM	*NCM(-)*
Mean	64.95892	65.03952
Variance	7.767831	9.461927
Observations	3718	1978
Hypothesized Mean Difference	0	
df	3705	
t Stat	-0.97216	
P(T<=t) one-tail	0.165518	
t Critical one-tail	1.645265	
P(T<=t) two-tail	0.331036	
t Critical two-tail	1.960604	

Source: Logistik Unicorps dataset obtained on 28 September 2009

Table 4.6: *t*-Test assuming unequal variance for female Officers

	Officers	*Officer(-)*
Mean	65.43312	65.45585
Variance	8.278184	8.482476
Observations	1594	709
Hypothesized Mean Difference	0	
df	1344	
t Stat	-0.17357	
P(T<=t) one-tail	0.431115	
t Critical one-tail	1.645988	
P(T<=t) two-tail	0.862229	
t Critical two-tail	1.961731	

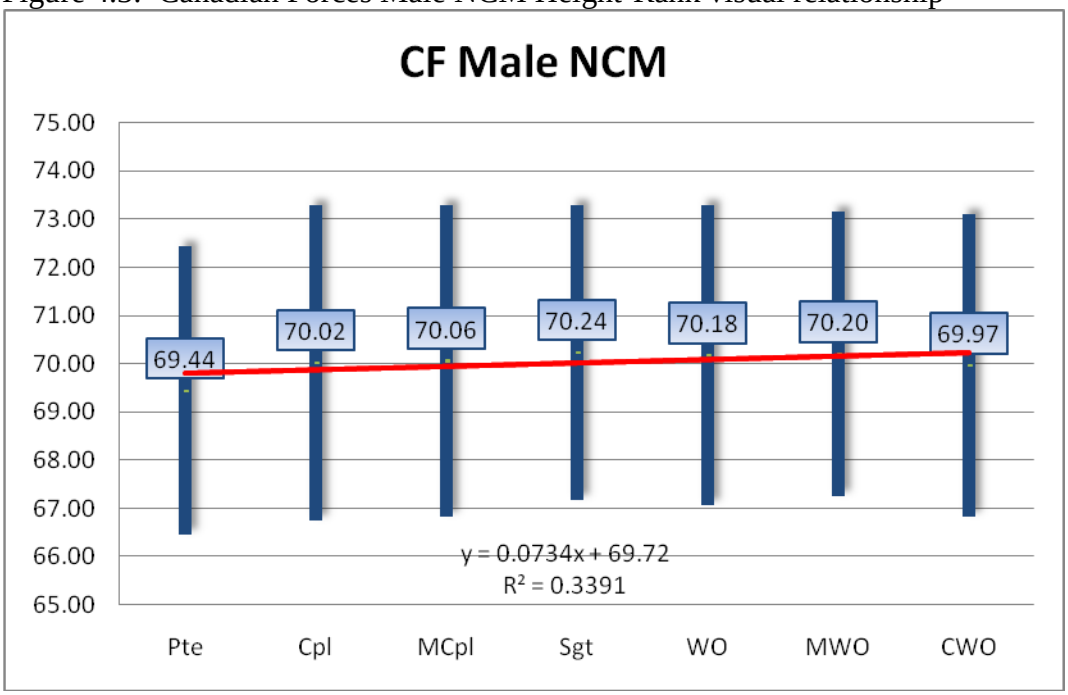
Source: Logistik Unicorps dataset obtained on 28 September 2009

Table 4.7: *t*-Test assuming unequal variance between male NCM(-) and Officers(-)

	NCM(-)	*Officer(-)*
Mean	70.08379	70.53255
Variance	10.26288	8.799141
Observations	11924	4044
Hypothesized Mean Difference	0	
df	7477	
t Stat	-8.14371	
P(T<=t) one-tail	2.23E-16	
t Critical one-tail	1.645057	
P(T<=t) two-tail	4.46E-16	
t Critical two-tail	1.960281	

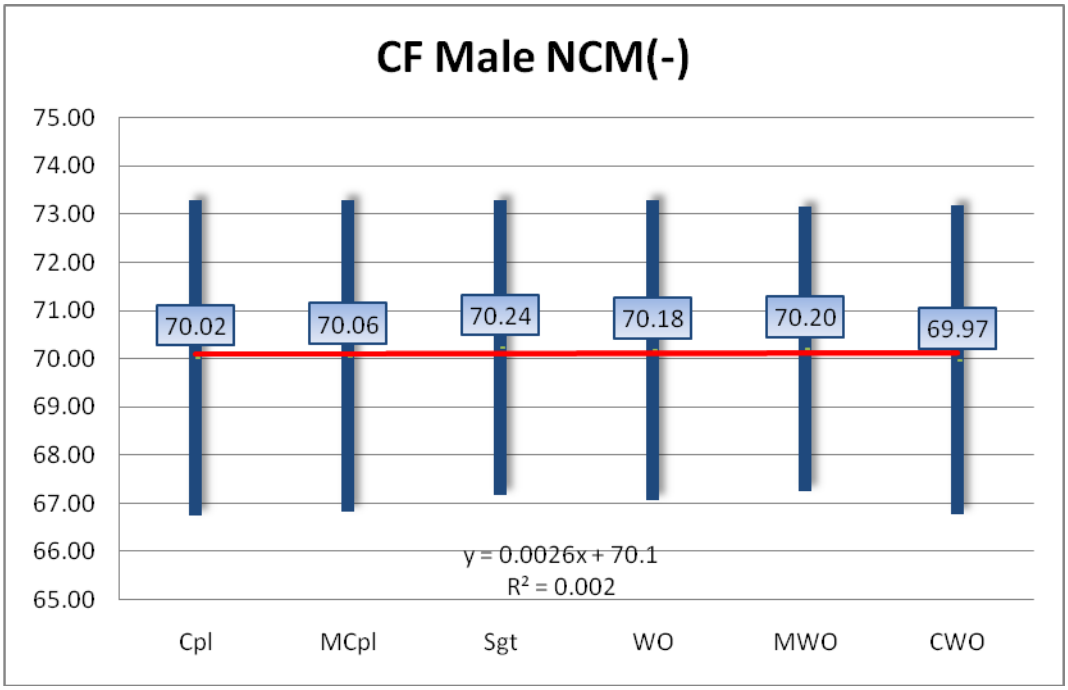
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure 4.3: Canadian Forces Male NCM Height-Rank visual relationship



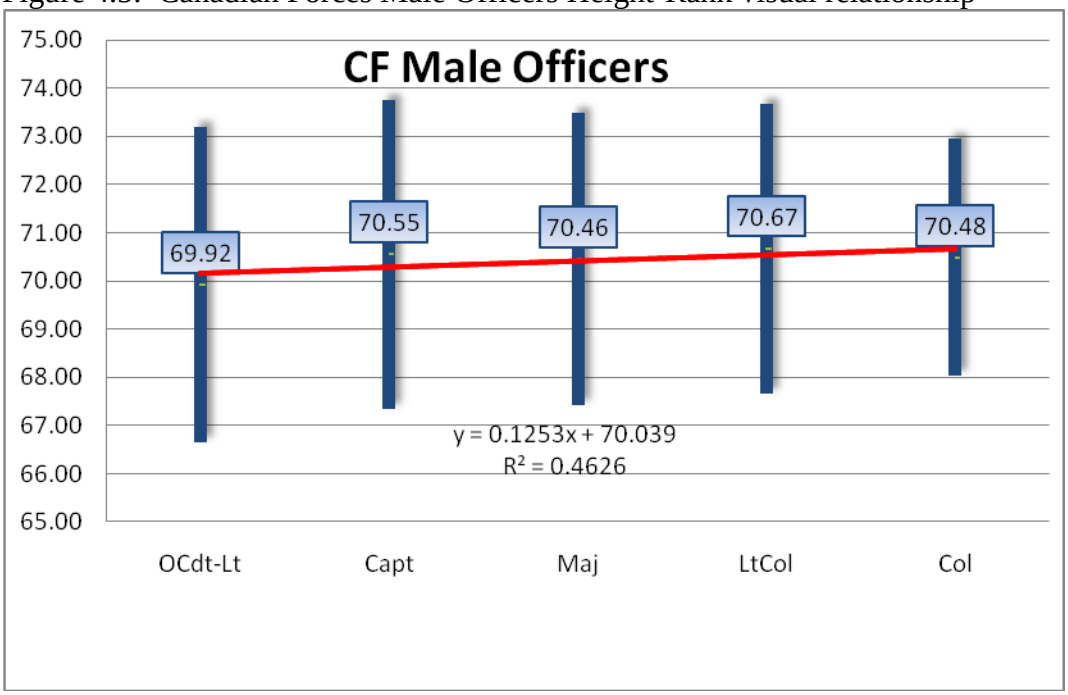
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure 4.4: Canadian Forces Male NCM Height-Rank (- junior ranks) visual relationship



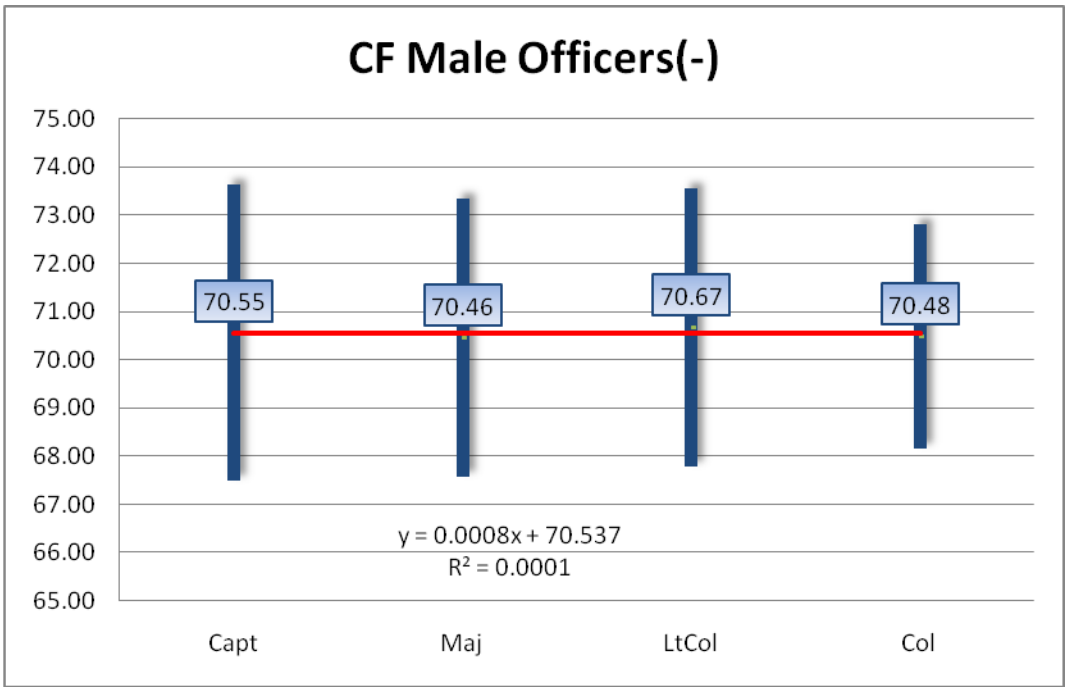
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure 4.5: Canadian Forces Male Officers Height-Rank visual relationship



Source: Logistik Unicorps dataset obtained on 28 September 2009

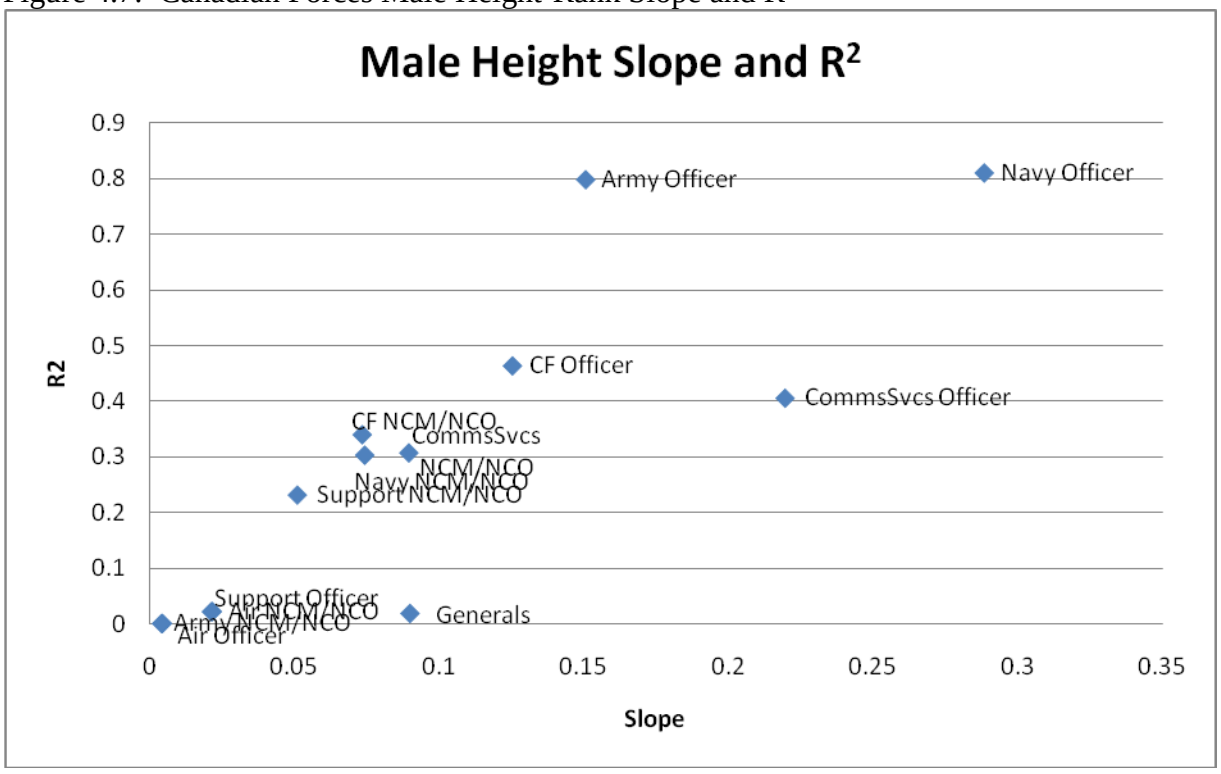
Figure 4.6: Canadian Forces Male Officers Height-Rank (- junior ranks) visual relationship



Source: Logistik Unicorps dataset obtained on 28 September 2009

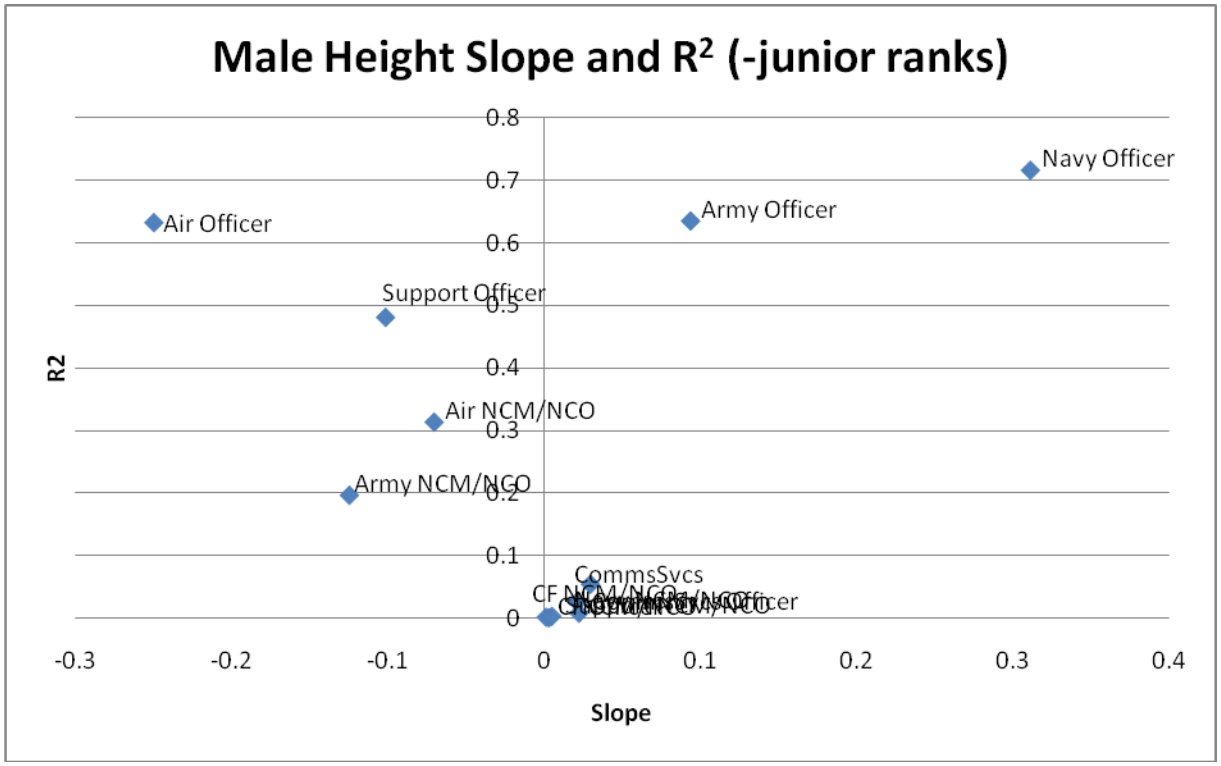
The first observation to be drawn from comparing the above Figures 4.3 to 4.4 and Figure 4.5 to 4.6 is that their slope has gone to almost zero when using the restricted ranks dataset. Figures 4.7 and 4.8 are a graphical representation of the slopes and R^2 obtained for all examined groups or sub-groups; the more to the upper-right a point is, the more rank-height bias is assumed for that group. Figures 4.9 and 4.10 used the same data but display columns based on the resulting product of the slope and R^2; although the scale would be different than the previous two figures, the higher the column is, the more rank-height bias is assumed for that group. In all the last four figures, it is easy to see the diminution of the impact of height over rank when using the restricted ranks datasets and this for all groups or sub-groups except for the Naval Officers who stay in their own category whatever the representation or the dataset group.

Figure 4.7: Canadian Forces Male Height-Rank Slope and R^2



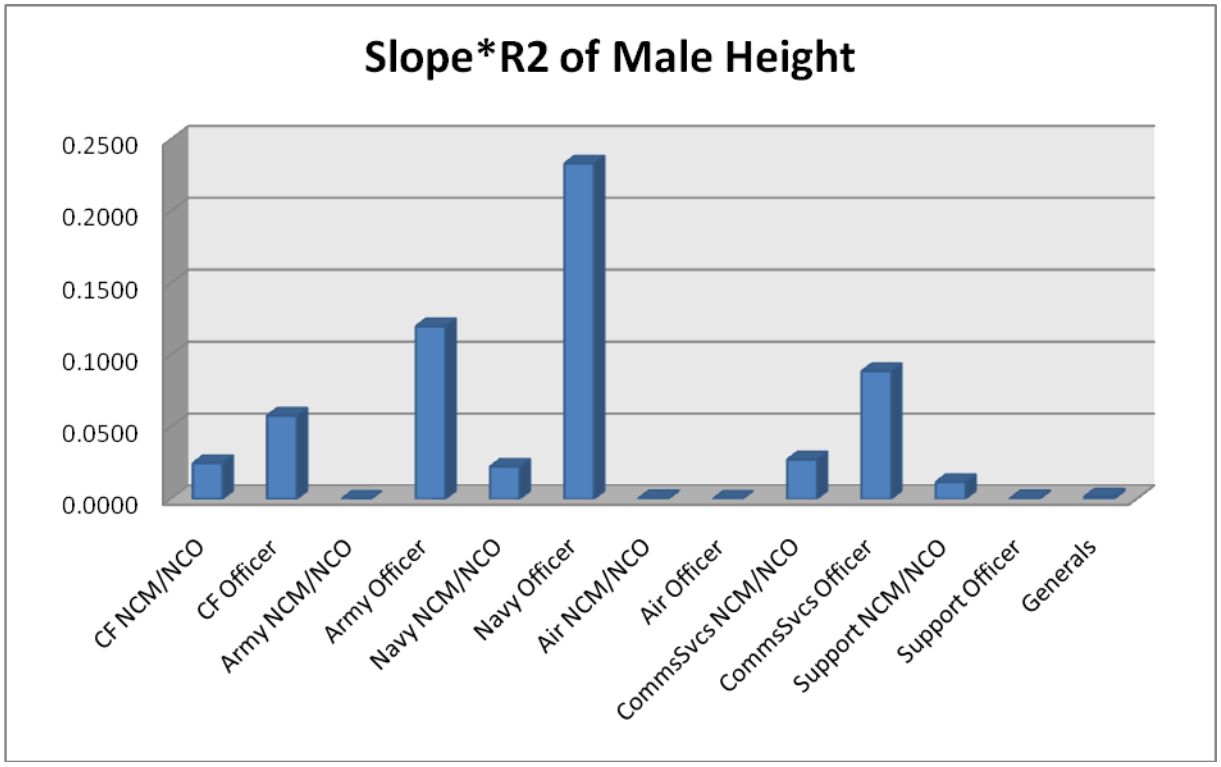
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure 4.8: Canadian Forces Male Height-Rank (- junior ranks) Slope and R^2



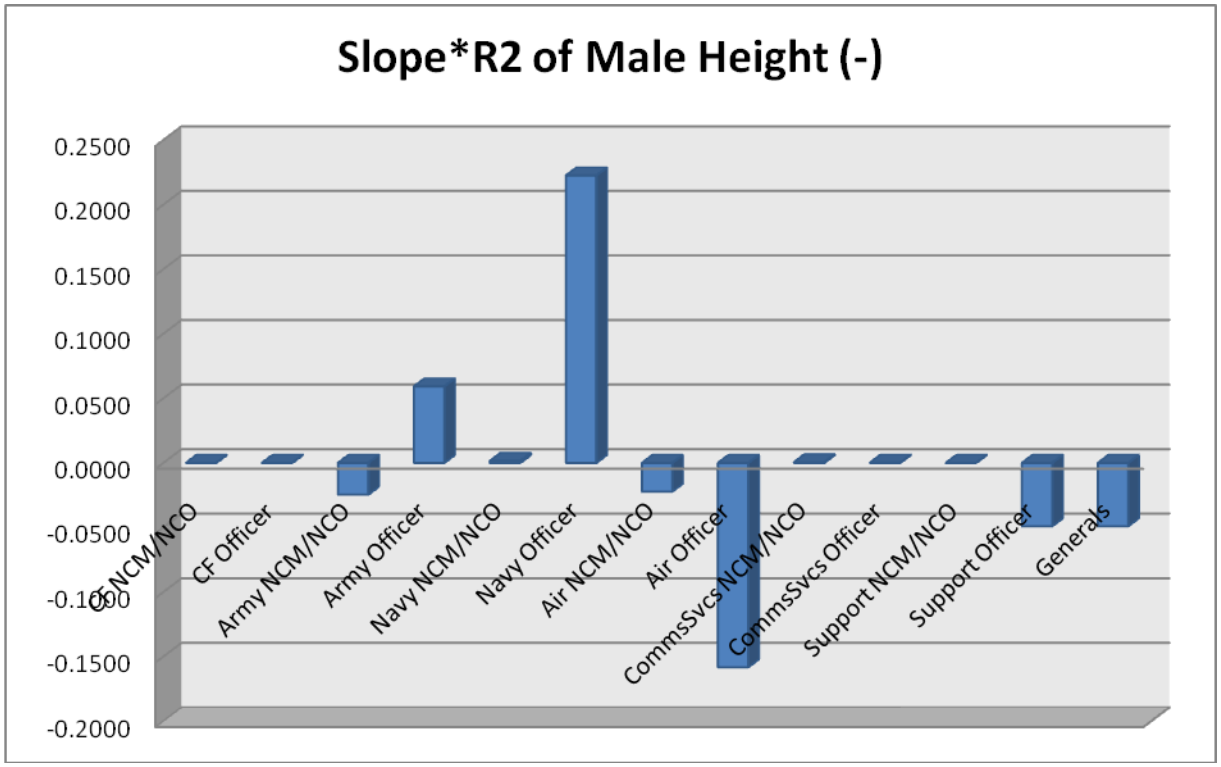
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure 4.9: Canadian Forces Male Height-Rank Slope*R^2



Source: Logistik Unicorps dataset obtained on 28 September 2009

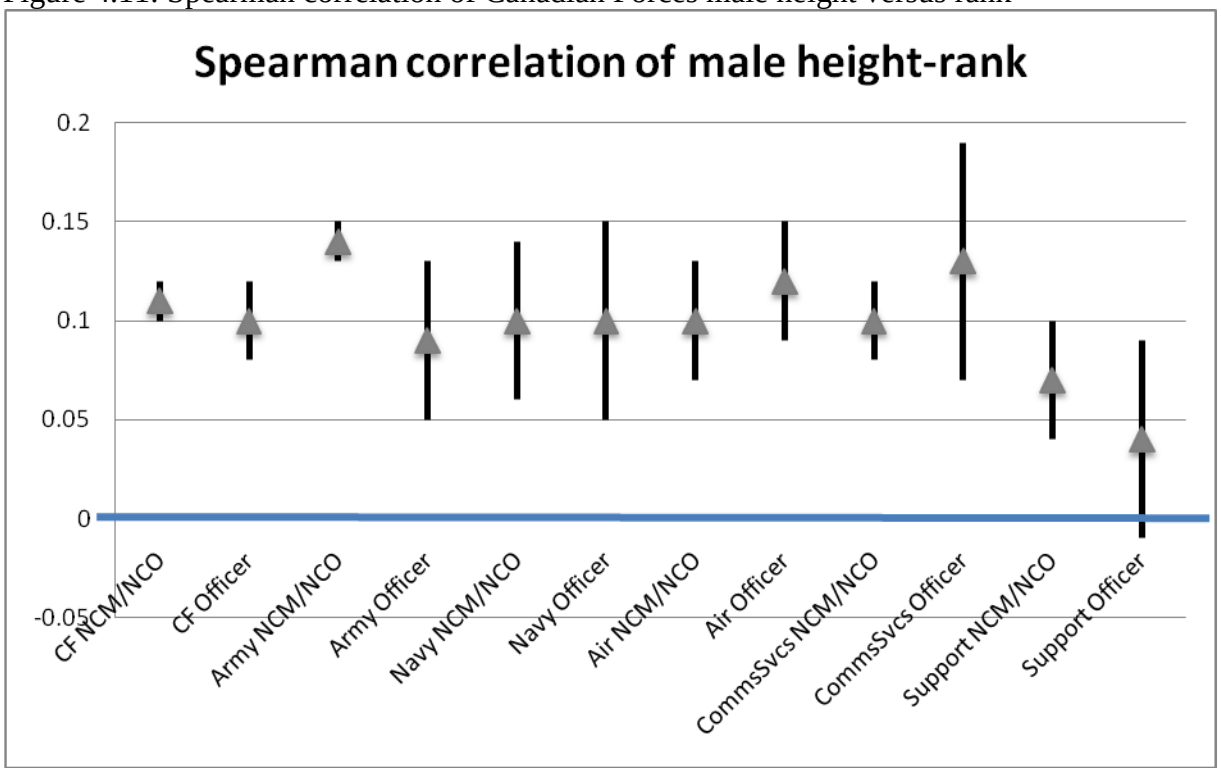
Figure 4.10: Canadian Forces Male Height-Rank (-junior ranks) Slope*R^2



Source: Logistik Unicorps dataset obtained on 28 September 2009

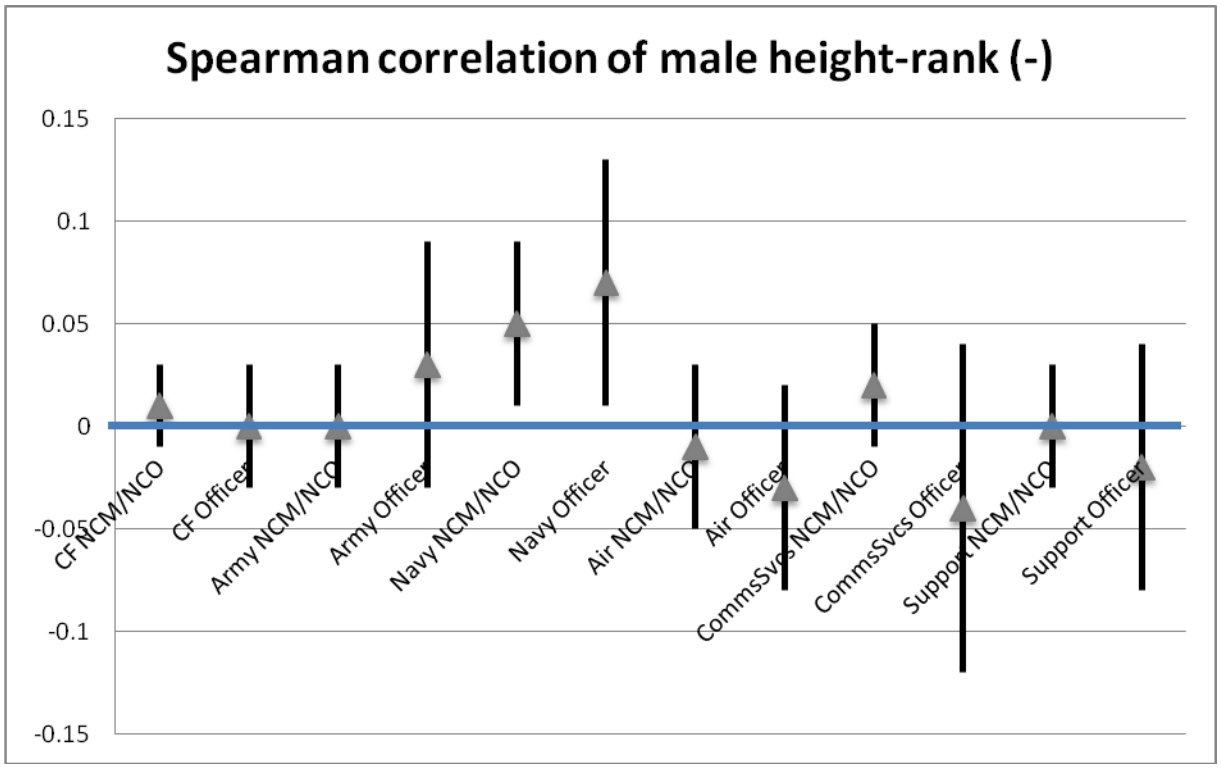
Although Figures 4.3 to 4.10 are visually appealing and easy to comprehend on the first look, they are also flawed at their origins because when the regression line is calculated between the height of each rank, it assumed not only an equal variance between those heights but also the same "weights". The problem is that the military rank structure is actually a pyramidal one and that the higher the rank, the lower the number of entries for that rank; thus as the line progress to the right along the rank structure, the more imprecise it becomes and this imprecision is not captured with the slope and R^2 numbers. Fortunately, a statistical method called Spearman's rank correlation coefficient does provide a better and more valid answer. The method provides a coefficient varying between minus one and one along with a confidence interval; when two variables are perfectly moving together in the same direction, the method will provide a coefficient of one, if they move perfectly but in the opposite direction, the result will be minus one, if they are not related the coefficient will be zero. Tables 4.11 to 4.14 show the Spearman's correlation coefficients along with the 95% confidence interval for both the NCM and the officers with their original datasets and those without the junior ranks.

Figure 4.11: Spearman correlation of Canadian Forces male height versus rank



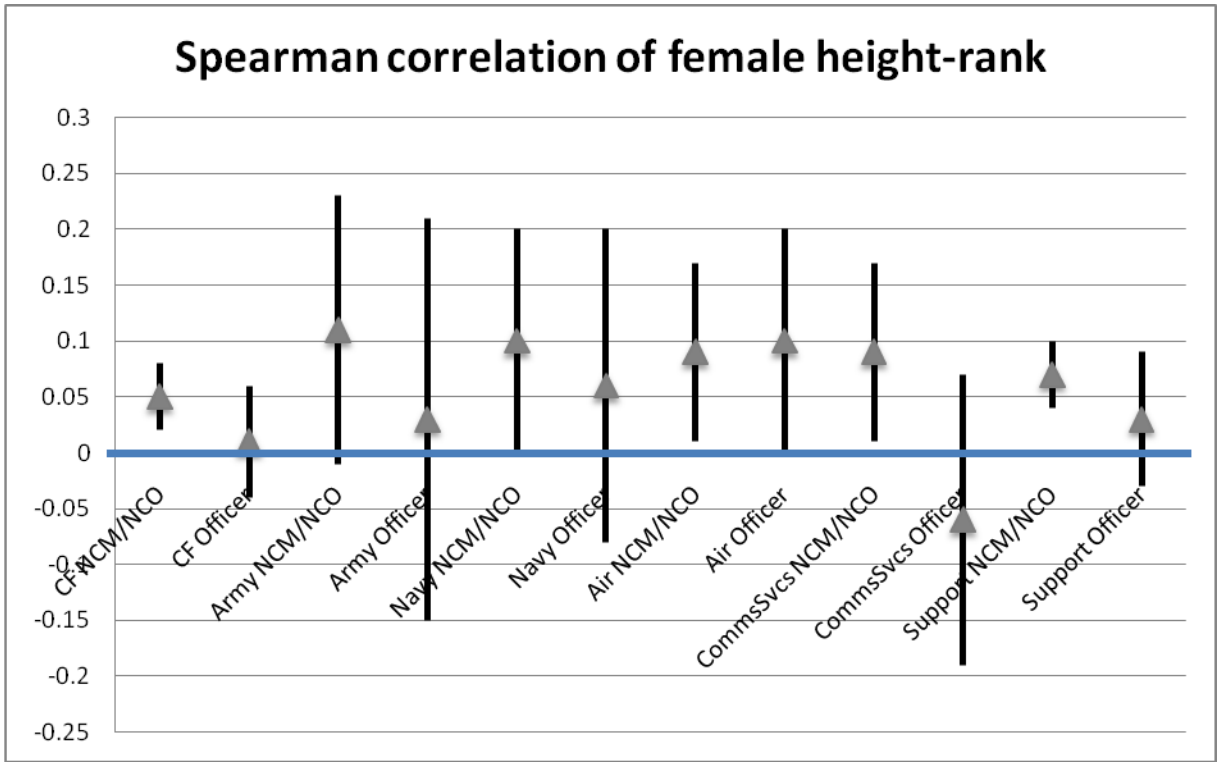
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure 4.12: Spearman correlation of Canadian Forces male height versus rank (- junior ranks)



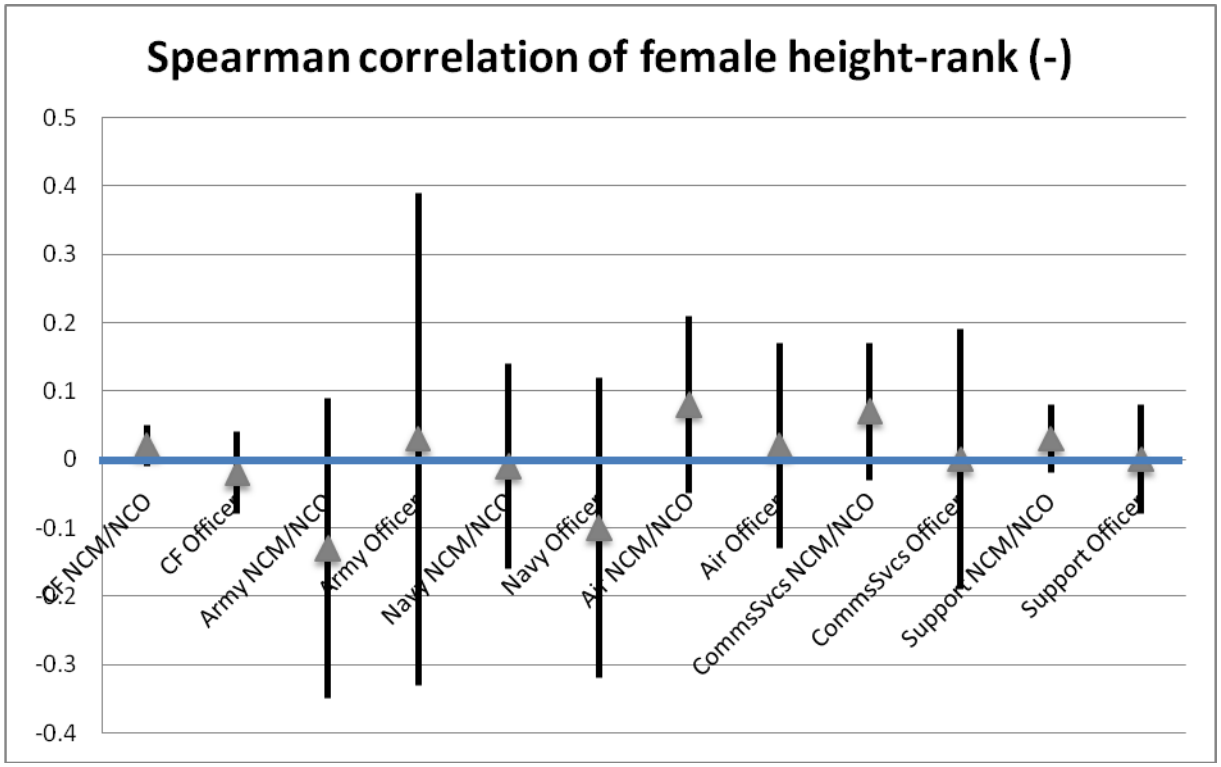
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure 4.13: Spearman correlation of Canadian Forces Female height versus rank



Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure 4.14: Spearman correlation of Canadian Forces female height versus rank (- junior ranks)



Source: Logistik Unicorps dataset obtained on 28 September 2009

What the above four figures first show is the importance of using the restricted datasets in order to remove the anomaly of the most junior ranks being shorter than all the subsequent ranks. Doing so not only brings down substantially the Spearman's correlation coefficient for both male and female, but additionally most of the coefficient 95% confidence interval now crosses the zero line. This is why it can be affirmed that except for the Male Navy NCM and Male Navy Officers, all CF branches do not have a height bias in their selection process and this for both male and female.

Senior Ranks and Height Bias

The following demonstrates that there is no height difference between the CF General ranks and the officers group but that there is a significant height bias when the CF selects its senior CWOs.

Because, the main dataset only has 38 entries for all the generals, most of them at the Brigadier or Major-General level, no valuable observations can be extracted from internal comparisons as the sample size would be insufficient. However, a comparison test can be performed between the Generals group and the Officers (minus junior ranks) in order to confirm if they can be considered the same. Table 4.8 shows the outcome of the *t*-Test assuming unequal variances between the Generals and the officers (-) datasets, both the *t* value and the *p* (T<=*t*) two-tail do not meet the criteria for declaring the groups statistically different. It can therefore be concluded that there is no height bias between the General rank level and the Officers.

Table 4.8: *t*-Test assuming unequal variance between Male Generals and Officers (-)

	Gen	*Officer(-)*
Mean	70.95395	70.53255
Variance	9.374511	8.799141
Observations	38	4044
Hypothesized Mean Difference	0	
df	38	
t Stat	0.844701	
P(T<=t) one-tail	0.201782	
t Critical one-tail	1.685954	
P(T<=t) two-tail	0.403565	
t Critical two-tail	2.024394	

Source: Logistik Unicorps dataset obtained on 28 September 2009

A very interesting finding is at the CWO rank level. Although CWO is the maximum rank achieved at the NCM level, some of them are actually subsequently selected (and not promoted) to occupy senior and more prestigious positions in the CF. Because those senior individuals are identified with a different MOSID number, the database is able to differentiate them and therefore create two datasets of CWO, the "normal" one (promoted) and the senior one (subsequently selected). Table 4.9 shows the outcome of the *t*-Test assuming unequal variances between those two groups. The results show that the groups are statistically different as both the *t*-Test criteria value is met and the *p* value is at 98% of certainty. Just looking at the average height of both groups is revealing; a senior CWO is on average 1.44 inches or 3.7 cm taller than a "regular" CWO. It is therefore concluded that there is a definite height bias when selecting a senior CWO out of the "regular" CWOs pool. The most likely explanation is that senior CWOs are subject to a subjective selection process instead of a more objective promotion process.

Table 4.9: *t*-Test assuming unequal variance between male senior CWO and CWO

	Senior CWO	*Other CWO*
Mean	71.21154	69.77292
Variance	7.798462	10.03547
Observations	26	168
Hypothesized Mean Difference	0	
Df	36	
t Stat	2.398783	
P(T<=t) one-tail	0.010877	
t Critical one-tail	1.688298	
P(T<=t) two-tail	0.021754	
t Critical two-tail	2.028094	

Source: Logistik Unicorps dataset obtained on 28 September 2009

Results Interpretations

This Chapter started with a declaration that the CF was a subset of the Canadian Society and as such, most of the obtained results should mirror or agree with the different observations brought in by the many different studies explored in Chapter 3. One such convergence or agreement is with regard to the sorting of height versus profession. Figures 4.1 and 4.2 demonstrate that in the CF, the Officers groups (both male and female) are almost half an inch taller on average than the NCM while the results of the *t*-Tests, for both males and females, show that both groups are statistically and significantly different in terms of height. Although a surprise for the author, this is exactly in line with many previous studies results which showed that professional/educated person are in general taller than non-professional/less educated persons. This starts with the beginning of the Traits theory when E.B. Gowin found out in 1915 that executives were taller than labourers.[126] It is later reconfirmed in 2008 by Case and Paxson who demonstrated that in both the UK and the USA, that taller workers are channelled toward

[126] Gowin, E.B., *The executive and his Control of Men* (Macmillan, 1915), 32

white-collar or highly-skilled jobs versus the more manual occupations.[127] An article by Cavelaars and others proposed the explanation that educational level is highly correlated with social class of origin, and social class of origin determines childhood living conditions, which affect growth.[128] Another complementary explanation by Persico, Postlewaite and Silverman is that only the height at 16 years old seems to matter with regard to future earning as an adult. They concluded that self-esteem and social effects (belonging to athletic or social clubs) might be at the root of the height versus wages/occupation disparities.[129] Whatever the explanation, the causes are outside the CF control.

As for the premise of this paper which was that the CF is better at selecting its leaders than the society it originates from because height is not a factor in its leaders selection. This was demonstrated by the fact that once the entry-level ranks are removed, all subsequent ranks for both the NCM and the Officers lineages are statistically identical, except for the Navy, in terms of height (figures 4.12 and 4.14). Additionally and even more convincingly, Table 4.8 showed that there is no statistical difference in height between the generals and the officers group they originate from. This last statistic is contrary to the both the fact that 30% of the Fortune 500 CEOs are over 74 inches[130] (versus 4% for the general US population) and the interpretation of Figure 3.7 by Case and Paxson which shows a positive correlation between height and earning

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[127] Ibid., 500

[128] Cavelaars and others, *Persistent Variations in Average Height between Countries and between Socio-Economic Groups: An Overview of 10 European Countries*, 408.

[129] Persico, Postlewaite and Silverman, *The Effect of Adolescent Experience on Labor Market Outcomes: The Case of Height*, 1032.

[130] Gladwell, *Blink: The Power of Thinking without Thinking*, 86-87.

(this last being used as a proxy for ranks).[131] However, the fact that height does not seem to be a discriminator in the CF when it is time for a promotion is neither a surprise nor a novelty in the modern military world. In effect, a 1935 article by David P. Page demonstrates that even 75 years ago, height was not an important leadership discriminator in West Point.[132] This is also in line with an observation made by Harold Burson who noted that short CEOs usually rise from within a company while the executive newcomers proposed by search firms are often above-average height.[133] This observation is very appropriate considering that military organizations always promote from within and it might explains why no changes to the CF promotion system is required (with the potential exception of the Navy).

The CF, not being perfect, does have some oddities within its promotion/selection system. One such oddity is shown in Table 4.9 where it is proven that senior CWOs are definitely taller in average than the group they originate from (1.44 inches more) and that there is a 98% certainty that the groups are statistically different. The most likely explanation for this anomaly is that senior CWOs are "selected" rather than promoted. In effect, the selection of a "senior" CWO is based not only on a more subjective annual evaluation report compared with the other ranks, but also on the results of special senior boards where personal opinions are more likely to prevail than regular promotion boards. Based on the fact that the numbers of CF CWOs along with the numbers of senior officers selecting them are both relatively small and that therefore most of them already know each other, human bias might be the possible culprit. In effect, this might be based on the information-processing school of leadership where the

[131] Case and Paxson, *Stature and Status: Height, Ability, and Labor Market Outcomes*, 502.

[132] Page, *Measurement and Prediction of Leadership*, 36.

[133] Jones, *Does Height Equal Power? some CEOs Say Yes*

selecting persons will evaluate/select a candidate based on their prototypical expectations or schematas of what a senior CWO should "look" like instead of only past performances. A possible way to prevent this effect might be to have outsiders like civilians from other government departments do the selection on the CF's behalf.

The main anomaly observed from the obtained data is the fact that the height of the entry level ranks for both NCM and the Officers are statistically and significantly smaller than their respective subsequent ranks. Because the phenomenon is present for both NCM and Officer, the previous explanation about the self-sorting of profession based on height cannot be valid here. In addition, it has been previously proven that there is no height discrimination for all subsequent ranks (besides senior CWO) and therefore, it is highly improbable that there is a form of height bias only at the entry ranks level. One possible explanation is that the CF, being a relatively open and non-discriminatory employer, offers to most people the chance to fulfill their potential as almost everyone is able to start military training although not everyone will finish it successfully. As to the why of the higher withdrawal rate that seems to be the case for shorter individuals, the author can only speculate that the physical training required in the military might be more strenuous for person of small stature along with the potential negative impact of less self-esteem.[134] However, although the data shows the existence of a kind of a barrier for the shorter persons at the entry ranks level, the fact that the CF average height as a whole is quasi identical to the Canadian population (see Figure C-1) also means that the CF seems to be very appealing to shorter persons. In fact, the implication is that there is an over-representation of below average height persons at the entrance-rank levels of both NCM and Officers. This is

[134] Persico, Postlewaite and Silverman, *The Effect of Adolescent Experience on Labor Market Outcomes: The Case of Height*, 1032.

therefore a good news story as the implication for shorter person is that although not everyone will succeed, everyone will have a fair chance and will be subsequently judged on their merits.

Conclusion

This Chapter proved that except for males in the Navy, height bias doesn't exist in the CF promotion system. It also showed that there is no differences in height between the Generals rank and the officers group. In addition, it was demonstrated that when an institution like the CF deviates from a relatively objective promotion system to a selection system, the height bias is definitely present as proven with the case of the senior CWO versus the "regular" CWO.

On the unexpected side (from the author perspective), it was shown that there is a definite and statistical difference in height between the officers and the NCM group in almost all CF services and this for both male and female (except for Female Comms & Services). This last finding is however in line with many studies introduced in Chapter 3 where there is a form of sorting of professions based on height. Finally, the dataset also shows that there seems to be a form of barrier for shorter people at the junior rank level of both male NCM and officers as those junior ranks are statistically shorter than the respective subsequent ranks.

CHAPTER 5 – CONCLUSION AND RECOMMANDATIONS

"Never measure the height of a mountain until you have reached the top. Then you will see how low it was." Dag Hammarskjold

Conclusion

This paper started with a description in chapter Two of the required backdrop by showing that there is a renewed interest in an improved leadership school of traits and that the information-processing school offers many interesting explanations about inferences and constructs related to physical attributes. Chapter Three has shown for its part that the height factor or height bias was present in many aspects of our society. First that height, although correlated to genetics, is also very strongly correlated to other environmental factors like parents' education, family income, class of origin and that those factors will influence childhood nutrition and general height. Second, that height is positively correlated with education and that taller people are more likely to end-up in a high-paying job. Third, although height is positively correlated to earning and intelligence, it was explained that when controlling for intelligence, there was still a significant height premium, thus debunking the idea that some researchers had that tall people get paid more because they are more intelligent. Finally, and on the anecdotal but interesting side, it has been depicted that the last time a US President was below average height was 110 years ago and that this could well be due to our societies wrongly using height as an indicator of leadership or performance and that this might also be why 30% of the Fortune 500 CEOs are above 6 ft 2in compared to 4% in society.

Chapter Four proved that except for males in the Navy, there is no height bias in the CF promotion system. When adding the fact that there is no differences in height between the Generals rank and the officers group, it can therefore be said that the almost complete absence of height bias in the CF promotion system proves that the CF is able to better select its leader than our society in general. However, the CF system is not perfect and when an institution like the CF deviates from a relatively objective promotion system to a selection process, the height bias is very present as proven with the case of the senior CWO versus the "regular" CWO.

There are two interesting findings not related to the promotion system. First, there is the fact that there is a definite and statistical difference in height between the officers and the NCM group in almost all CF services and this for both male and female (except for Female Comms & Services). This is however in line with many studies introduced in Chapter 3 where there is a form of sorting of professions based on stature. Second and last, there seems to be a form of barrier for shorter people at the junior rank level of both male NCM and officers as those junior ranks are statistically shorter than the respective subsequent ranks.

Recommendations

The CF should review its selection process for senior CWO as although relatively minor in actual number of person being affected, it has the actual biggest height bias in the CF with the senior CWOs being 1.5 inches taller than the "regular" CWO. One possibility could be to have senior CWOs selected by DND outsiders.

The Navy should be made aware of the height bias happening within their promotion system and the numbers could be revisited every five years to confirm any change in trends.

The fact that the entrance-level ranks are shorter than the subsequent ranks along with the fact that the CF as a whole is almost at parity with the Canadian population in term of height suggest that the CF appealing to shorter persons but that for different reasons, they do not stay with the CF past the entrance ranks level. This is something that a sociologue could look at in order to better understand the variables at play and improve the recruitment system.

Finally, the author was able to obtain the large dataset by having any names or identifier removed at the source. Something similar could be done with other organizations like a national police organization or the military forces of another country. A review of many academic databases or the Internet shows that this has not yet been written or published.

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ANNEX A - CANADIAN FORCES RANK STRUCTURE AND TRADES

The Canadian Forces personnel has two rank structures, one being the Officers and the other one being the Non-Commissioned Members (NCM) which include the Non-Commissioned Officers (NCO). The NCM structure (previously known as the "men") is for people who at the time of their enrolment had a high-school education and went on to learn a military trade such as infantry, driver, aircraft technician or radio operator. As for the Officers structure, it is for people who usually have a university degree or show the potential for one and are sent to the Royal Military College, a Canadian Forces university. Both structures are parallel and do not intersect although there are some provisions for some NCM to become an officer if selected or if he/she demonstrated superior leadership skills along with academic potential. A simplistic view would be to see the Officers as managers or white-collar and the NCM as the workers or blue-collar. Leadership qualities are a must for all in the Officers structure while it starts at the Master-Corporal level in the NCM structure and its requirement subsequently increases with each rank. Following are two tables showing the increasing rank structures of both the Officers and NCM/NCO for the CF. The assigned value column was used to convert a rank into a numerical value for comparison purpose; rank comparison is only done internal to a rank structure. For simplicity purpose, the Army/Air Force rank appellation will be used in all graphs or tables.

Table A-1 Canadian Forces Officer Rank Structure

Officer Category	Army and Air Force	Navy	Assigned Value
Subordinate Officer	Officer Cadet (OCdt)	Naval Cadet (NCdt)	11
Junior Officers	Second Lieutenant (2Lt)	Acting Sub-Lieutenant (A/SLt)	11
	Lieutenant (Lt)	Sub-Lieutenant (SLt)	11
	Captain (Capt)	Lieutenant (Lt (N))	12
Senior Officers	Major (Maj)	Lieutenant-Commander (LCdr)	13
	Lieutenant-Colonel (LCol)	Commander (Cdr)	14
	Colonel (Col)	Captain (Capt (N))	15
General Officers	Brigadier-General (BGen)	Commodore (Cmdre)	21
	Major-General (MGen)	Rear-Admiral (RAdm)	22
	Lieutenant-General (LGen)	Vice-Admiral (VAdm)	23
	General (Gen)	Admiral (Adm)	24

Source: (Canadian Forces)

Table A-2: Canadian Forces NCM Rank Structure

NCM Category	Army and Air Force	Navy	Assigned Value
Junior Non-Commissioned members	Private Recruit (Pte (Recruit))	Ordinary Seaman (OS)	1
	Private (Pte)	Able Seaman (AB)	1
	Corporal (Cpl)	Leading Seaman (LS)	2
	Master Corporal (MCpl)	Master Seaman (MS)	3
Senior Non-Commissioned members	Sergeant (Sgt)	Petty Officer 2nd class (PO 2)	4
	Warrant Officer (WO)	Petty Officer 1st class (PO 1)	5
	Master Warrant Officer (MWO)	Chief Petty Officer 2nd class (CPO 2)	6
	Chief Warrant Officer (CWO)	Chief Petty Officer 1st class (CPO 1)	7

Source: (Canadian Forces)

The three main branches or elements of the CF are Navy, Army and Air Force. Those lasts are supported by two additional branches called Communications and Services Branch and the Support Branch. The next table shows all the trades and professions associated with each Branch. Each of the trades/professions has a unique identifier or number called MOSID (Military Occupation Service IDentification). Those numbers were used to allocate each individual in the Logistik database into a specific branch for analysis purpose.

Table A-3: Canadian Forces Branches and associated trades/professions

Navy	Army	Air Force
MARS	Land LCols	Air LCols
MS ENG	ARMD	ACSO
NAV ENG	ARTY	AEC
NCS ENG	EME	AERE
	ENGR	CONST ENGR
Sea CPO1s	INF	PLT
BOSN		
CL DVR	Land CWOs	Air CWOs
E TECH	ARTYMN AD	AC OP
H TECH	ARTYMN FD	ACS TECH
MAR EL	CBT ENGR	AES OP
MAR ENG ART	CRMN	AVN TECH
MAR ENG ME	EO TECH (L)	AVS TECH
MAR ENG TEC	INFMN	FLT ENGR
NAV COMM	MAT TECH	MET TECH
NCI OP	VEH TECH	NDT TECH
NE TECH(A)	W TECH L	SAR TECH
NE TECH(C)		
NE TECH(M)		
NE TECH(T)		
NES OP		
NW TECH		
SONAR OP		
STWD		

Communications and Services	Support	
Svcs LCols	Supt LCols	Ill and Injured
CELE (AIR)	BIO	AMMO TECH
INT	CHAP	BE TECH
MPO	DENT	COOK
PAO	HCA	CRT RPTR
SIGS	HSO	DENT TECH
	LEGAL	MED TECH
ATIS TECH	LOG	MLAB TECH
CE SUPT	MED	MRAD TECH
COMM RSCH	MUSC	MSE OP
CONST TECH	NUR	MUSCN
ED TECH	PHARM	POST CLK
EGS TECH	PHY TH	RMS CLK
FIRE FTR	PSEL	SUP TECH
GEO TECH	SOCW	TFC TECH
IMAGE TECH	TRG DEV	
INT OP		
LCIS TECH		
LMN		
MP		
PH TECH		
RM TECH		
SIG OP		
WFE TECH		

Source: Canadian Forces, Canadian *Forces Branches and associated trades/professions*, Defence Wide Area Network, http://hr.ottawa-hull.mil.ca/dgmc/engraph/mfinder_e.asp?Opensub=10 (accessed February 16, 2010).

ANNEX B - DATA ORIGIN, FILTERING AND DESCRIPTION

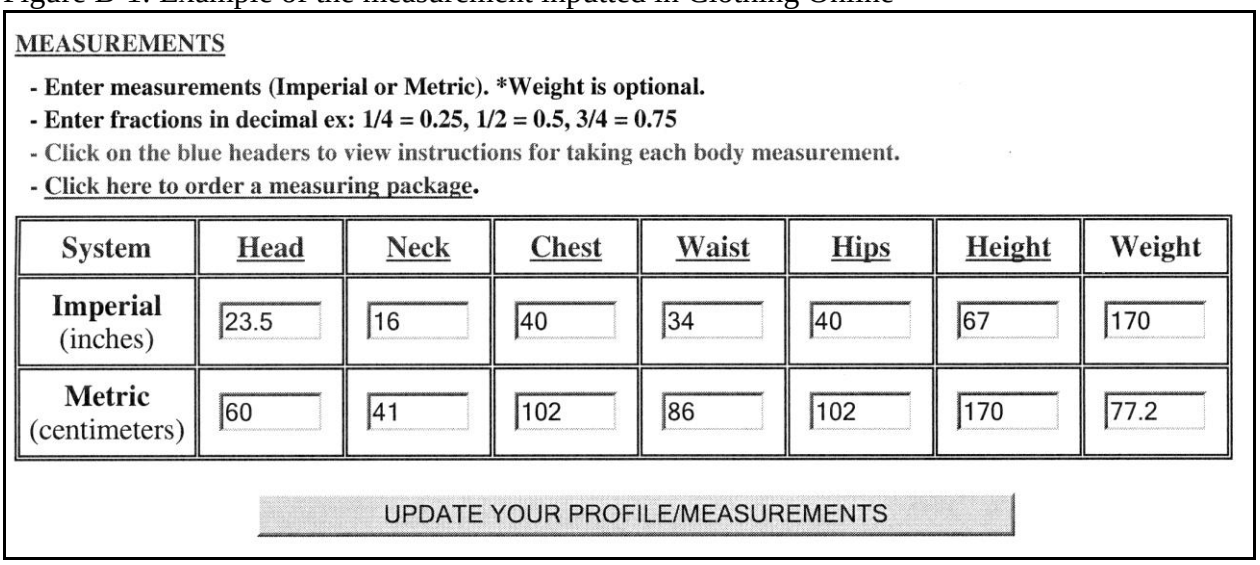
Data Origin

The CF like any large security organization collects a lot of data about its members for either security or administrative reasons. One such set of data belongs to a company called Logistik Unicorp Inc. This Company is in charge of a program called Clothing Online and which "is an initiative contracted by the Department of National Defence aimed at providing the direct delivery of non-operational clothing to CF Members."[135]

Although not mandatory, every member of the CF must have a profile with the Clothing Online program in order to be able to order and receive non-operational clothing. The profile in question is based on numbers self-entered by the member and it includes personal measurements such as weight and height. Below is a scan showing the different measurements used by the Clothing Online in order to suggest the best fit for the clothing being ordered. Note that once a number is entered into a case, its equivalent in either metric or imperial is automatically calculated in the adjoining case above or below.

[135] Logistik Unicorps Inc., "CF Clothing Online Registration," https://www.logistikunicorp.com/DND/DndGetAccess.asp?lang=E&a=1 (accessed February 20, 2010).

Figure B-1: Example of the measurement inputted in Clothing Online



MEASUREMENTS

- **Enter measurements (Imperial or Metric). *Weight is optional.**
- **Enter fractions in decimal ex: 1/4 = 0.25, 1/2 = 0.5, 3/4 = 0.75**
- **Click on the blue headers to view instructions for taking each body measurement.**
- **Click here to order a measuring package.**

System	Head	Neck	Chest	Waist	Hips	Height	Weight
Imperial (inches)	23.5	16	40	34	40	67	170
Metric (centimeters)	60	41	102	86	102	170	77.2

UPDATE YOUR PROFILE/MEASUREMENTS

Source: Extract from author's profile on Clothing Online from Logistik Unicorps Inc.

After some searching, the author succeeded in finding and contacting Mr. Richard Lepage (who is here formally thanked), an employee of Logistik Unicorps acting as a liaison officer with the CF. This person provided the author with the main data required for this paper, i.e. the data of 58,388 individuals for the following fields: Gender, Rank, Component, MOSID and Height. The obtained file is based on a dynamic database and it was obtained on 28 September 2009. Besides one or two individuals, the selection of those specific fields does not allow the association of the data to an individual, thus permitting Mr Lepage to provide the data at an unclassified level. It must be understood that the database although relatively large, is not complete as not all CF members are part of it and that it represents a picture frozen in time. Besides that, the sheer quantities of data obtained should provide confidence in most of the actual data interpretations. For future reference and archival purposes, the file containing the original data used in this paper will be provided to the Information Research Center (IRC) of the Canadian Forces College in Toronto, Ontario.

The first step applied to the data was that only the Regular force members (component) were kept for analysis purpose in order to have a uniform background. Doing so eliminated many entries and the total of entries went from 58,388 to 36,555. A first look at the height data (in inches) showed some minor anomalies like numbers between 1.5 and 1.9. Those numbers were deemed to be metric numbers inserted into the wrong location and therefore they were simply converted to the imperial system (inches). Another minor problem was that there was a small number of entries where navy ranks were mixed with non-navy trades and vice-versa. When this happened, the priority was given to the trade (MOSID number) so that, for example, a master-corporal steward was converted to master-seamen steward.

However, the main anomaly detected in the data was the presence of many height numbers which were deemed too short to either be true or for such a short person to be able to join the military (ex. 36 inches). This is why, it was decided to remove all the individuals for which the associated height was 50 inches or less, this resulted into 105 entries being removed. Thus the database used for analysis contained 36,450 entries or individuals. It is to be noted that 50 inches was very subjectively selected to be as the minimum possible height and that the author believes it might even be too conservative and that it should be higher. However, the number 50 was selected in order to present unbiased data and it is assessed that it did not affect the outcome as only 41 out of 36,450 reported their height to be between 50 and 56 inches.

It must also be noted that the general officers and officer-cadets were considered separately from the officers because of their small numbers. In addition, Generals lose their affiliation with their elements of origin while having their own unique MOSID (#172). As for the officer-cadets, they can either be part of a profession belonging to a branch or be part of a unique officer-cadet MOSID (#240) depending where they are in their career. More interesting

is the case of the chief-warrant officers/chief-petty officer first-class which can be either part of their original trade or part of the senior CWO/CPO1 MOSID (#351). To be part of this last trade, one must be selected and this last fact does have interesting implications which are dealt with in another section.

Data Splitting

The most important factor when considering the adult height of a population is the sex of the individual, this is why the first step taken with the database is the actual separation of the male and female data. The second step taken is a further division of the data between the officer and NCM ranks structures and this for both male and female. Finally, each sub-group is divided further based on the branch origin of the individual's trade. Table B-1 shows how the data was divided for analysis purpose. The numbers in parenthesis "( )" are the actual qty of entries in the dataset or sub-group, the average height in inches and its standard deviation. It is to be noted that the last column sub-totals of entries do not equal the numbers reported in the third column. This is due to the fact that 210 entries are without a MOSID number, the very large majority of those being at the officer-cadet or private rank level and the fact that 4 entries have a wrong MOSID number, thus the total number of 214 unallocated entries that can be seen in the Table B-1.

The numbers in brackets "[ ]" serve to describe and test the "normality" of a dataset distribution. They are in order: Skewness, Kurtosis and the outcome of the Shapiro-Wilk test (W and *p*). The Skewness is the measure of the asymmetry of the probability distribution with 0 being a perfect symmetry. The Kurtosis measures both peakness and tail heaviness of a distribution relative to that of the normal distribution. In this case, the Kurtosis value should be

between -3 and 3 with the ideal result being zero. The Shapiro-Wilk test tests the null hypothesis that a dataset came from a normally distributed population. While not perfect, it is considered one of the best available tests for normality. W is the confidence level of the hypothesis and it should be above 0.95 while *p* is the calculated value of the probability of rejecting the attribution of the normal distribution attribute to a dataset when it is actually true, thus the smaller the better. All datasets, except for the male generals, female NCM army and female NCM navy (minus junior ranks), have a W >= 0.95, thus they all can be said to be normal while the others should be looked at with more circumspection when interpreting their meanings.

Table B-2 is for the same dataset as the previous table but with the most junior ranks removed for both officers and NCM. For this dataset, the private, officer-cadet, second lieutenant and lieutenant ranks, along with their navy equivalents, were removed from the group. Besides the obvious but unrelated fact that the CF is a very young one as half the entries are gone when we remove the most junior rank, what can be seen is that almost all of the MOSID non-allocated entries are gone as most of them were originally at the junior level rank level. The reason for creating this new dataset is explained in chapter Four.

Table B-1: Division and description of the database entries

All (36,450)	Male (31,138, 69.88, 3.11)	NCM (23,490, 69.77, 3.12) [-0.19, 1.05, 0.97, <0.0001] Including 169 non-allocated	Army (9,073, 69.69, 3.05) [0.05, 0.38, 0.97, <0.0001]
			Navy (2,941, 69.92, 3.12) [-0.46, 1.39, 0.97, <0.0001]
			Air Force (3,520, 69.75, 3.07) [-0.20, 1.02, 0.98, <0.0001]
			Comms & Svcs (4,103, 69.91, 3.23) [-0.29, 1.52, 0.97, <0.0001]
			Support (3,658, 69.66, 3.19) [-0.38, 1.74, 0.97, <0.0001]
			Senior CWO/CPO1 (26, 71.21, 2.74) [0.78, 1.23, 0.95, 0.2482]
		Officers (7,648, 70.25, 3.07) [-0.17, 1.19, 0.98, <0.0001] Including 25 non-allocated	Army (1,728, 70.27, 3.05) [0.09, 0.62, 0.98, <0.0001]
			Navy (1,115, 70.31, 3.21) [-0.38, 1.47, 0.97, <0.0001]
			Air Force (2,180, 70.4, 2.84) [-0.19, 1.19, 0.98, <0.0001]
			Comms & Svcs (873, 70.21, 3.19) [0.07, 0.78, 0.98, <0.0001]
			Support (1,222, 70.05, 3.20) [-0.36, 1.92, 0.97, <0.0001]
			Generals (36, 70.9, 3.06) [-1.11, 3.14, 0.93, 0.022]*
			Ocdt (469)
	Female (5,312, 65.10, 2.82)	NCM (3,718, 64.96, 2.79) [0.30, 1.41, 0.95, <0.0001] Including 15 non-allocated	Army (202, 64.83, 2.65) [0.24, 1.37, 0.90, <0.0001]*
			Navy (257, 65.14, 2.72) [0.56, 0.62, 0.95, <0.0001]
			Air Force (343, 64.81, 2.72) [0.07, 0.89, 0.95, <0.0001]
			Comms & Svcs (446, 65.60, 3.00) [0.18, 0.48, 0.96, <0.0001]
			Support (2,455, 64.85, 2.76) [0.19, 1.53, 0.96, <0.0001]
			Senior CWO/CPO1 (0)
		Officers (1,594, 65.43, 2.88) [0.02, 0.56, 0.97, <0.0001] Including 5 non-allocated	Army (85, 65.52, 2.72) [0.24, -0.48, 0.96, 0.015]
			Navy (150, 65.69, 2.84) [-0.07, 0.79, 0.96, 0.001]
			Air Force (264, 65.71, 2.66) [0.48, -0.45, 0.95, <0.0001]
			Comms & Svcs (142, 65.46, 2.68) [0.33, -0.40, 0.96, <0.0001]
			Support (823, 65.15, 2.85) [-0.17, 0.95, 0.97, <0.0001]
			Generals (0)
			OCdt (125)

Source: Logistik Unicorps dataset obtained on 28 September 2009

Table B-2: Division and description of the database entries with the junior ranks removed

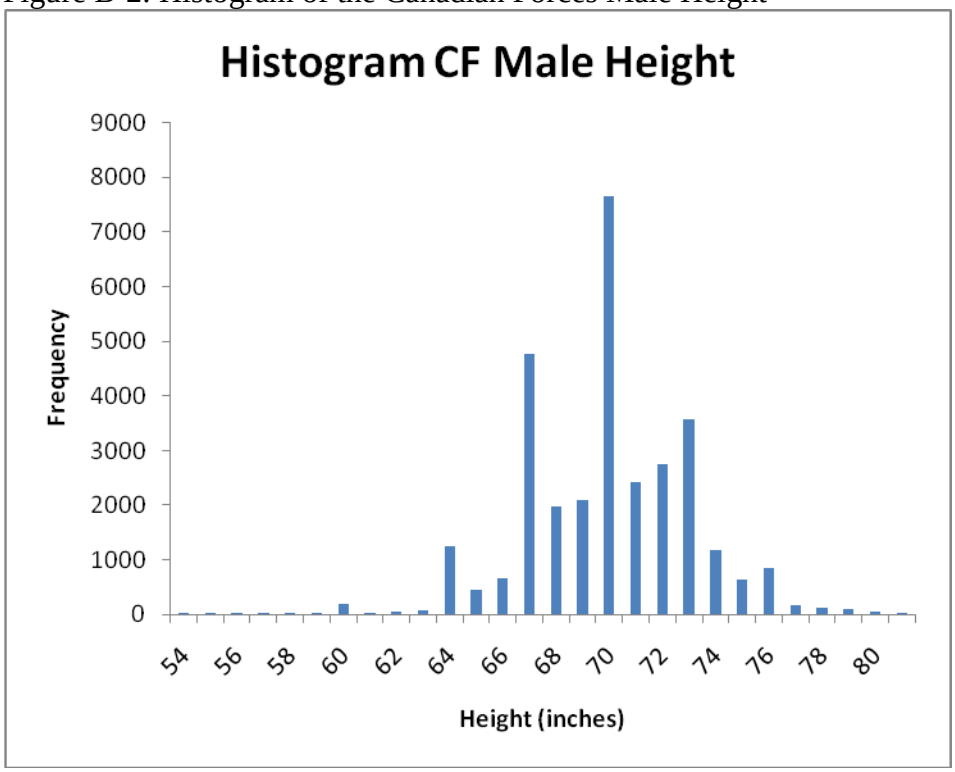
All (18,655)	Male (16,006, 70.20, 3.15)	NCM (11,924, 70.08, 3.20) [-0.42, 1.93, 0.97, <0.0001] Including 3 non-allocated	Army (2,939, 70.27, 3.14) [-0.23, 1.48, 0.98, <0.0001]
			Navy (1,792, 70.10, 3.18) [-0.68, 1.96, 0.96, <0.0001]
			Air Force (2,140, 70.02, 3.05) [-0.37, 1.96, 0.98, <0.0001]
			Comms & Svcs (2,658, 70.14, 3.30) [-0.42, 2.09, 0.97, <0.0001]
			Support (2,366, 69.82, 3.31) -0.48, 2.09, 0.97, <0.0001]
			Senior CWO/CPO1 (26, 71.21, 2.74) [0.78, 1.23, 0.95, 0.2482]
		Officers (4,082, 70.54, 2.97) [-0.17, 1.41, 0.98, <0.0001] Including 2 non-allocated	Army (790, 70.51, 2.94) [-0.03, 1.16, 0.99, <0.0001]
			Navy (628, 70.5, 3.19) [-0.49, 1.21, 0.97, <0.0001]
			Air Force (1,259, 70.76, 2.68) [-0.22, 1.62, 0.98, <0.0001]
			Comms & Svcs (527, 70.62, 3.06) [0.19, 1.45, 0.98, <0.0001]
			Support (840, 70.18, 3.13) [-0.12, 1.36, 0.98, <0.0001]
			Generals (36, 70.9, 3.06) [-1.11, 3.14, 0.93, 0.022]*
	Female (2,687, 65.15, 3.04)	NCM (1,978, 65.04, 3.08) [0.23, 1.51, 0.98, <0.0001]	Army (50, 65.19, 3.39) [-0.45, 2.28, 0.96, 0.069]
			Navy (121, 65.43, 3.04) [0.41, 0.62, 0.90, 0.045]*
			Air Force (169, 64.88, 2.92) [0.16, 0.08, 0.99, 0.136]
			Comms & Svcs (267, 65.71, 3.17) [-0.03, 0.79, 0.98, 0.006]
			Support (1,371, 64.89, 3.05) [0.30, 1.96, 0.97, <0.0001]
			Senior CWO/CPO1 (0)
		Officers (709, 65.46, 2.91) [0.03, 0.82, 0.98, <0.0001] Including 2 non-allocated	Army (23, 65.53, 3.13) [0.40, -0.03, 0.97, 0.651]
			Navy (56, 66.06, 3.34) [-0.08, 0.97, 0.97, 0.286]
			Air Force (118, 66.03, 2.78) [0.34, -0.71, 0.97, 0.005]
			Comms & Svcs (74, 65.36, 2.98) [0.40, -0.33, 0.97, 0.051]
			Support (436, 65.23, 2.83) [-0.15, 1.43, 0.98, 0.0001]
			Generals (0)

Source: Logistik Unicorps dataset obtained on 28 September 2009

Data Description

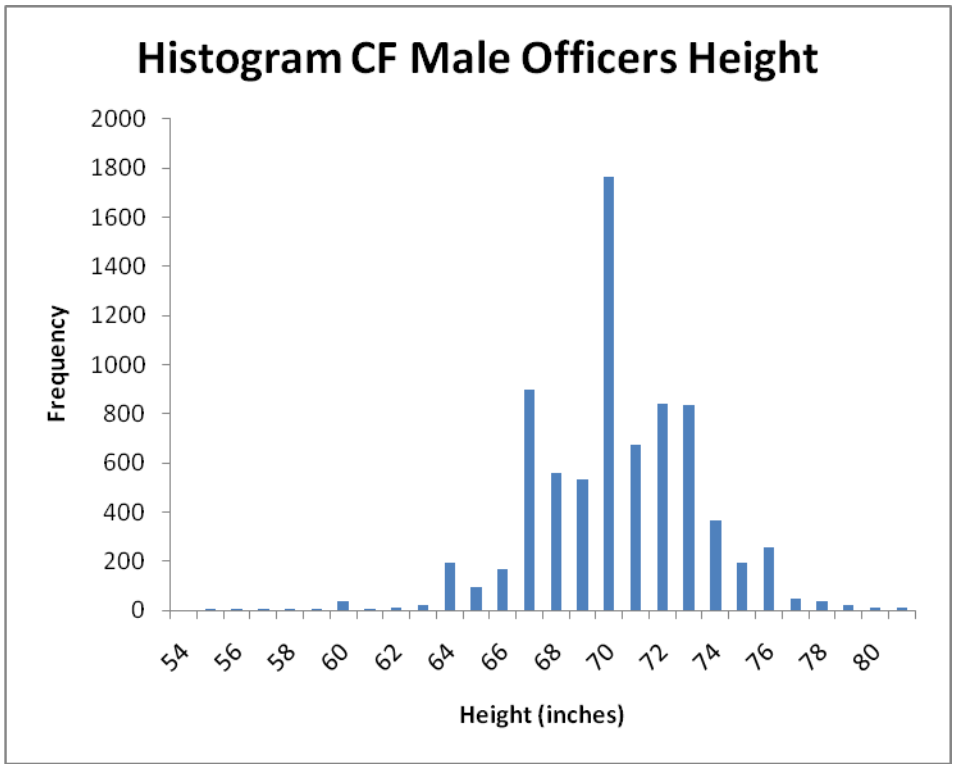
Although the qualities of conformity to a normal distribution can be expressed in numbers as in the previous table, the best way to actually decide if it is such a distribution is still to see it in a graphical way. Not all the previous sub-groups shown in the previous two tables are shown as there would have been a lot of repetition. The 6 next figures (B-2 to B-7) show the actual graphs of the distribution for both males and females, of the CF, NCM and Officers. It will be immediately noticed that although the graphics are normal distribution, they are not perfect. The male distributions have two peaks at 67 and 70 inches while the female distributions have their peaks at 63 and 67 inches and this for either the combined, NCM or Officers distributions shown in figures B-2 to B-7. Interestingly, the figures B-8 to B-11 which show the histograms for the same data but with the junior ranks removed (Private, Officer-cadet, Second-Lieutenant and Lieutenant) demonstrate that the anomalies or peaks observed in figure B-2 to B-7 are quite subdued, although still present. A tentative explanation for those peaks is provided in Annex C. Besides those interesting anomalies, what these graphs are showing is that for a same gender, the datasets can be subdivided from a combined one to NCM and officers while keeping most of their characteristics about normality.

Figure B-2: Histogram of the Canadian Forces Male Height



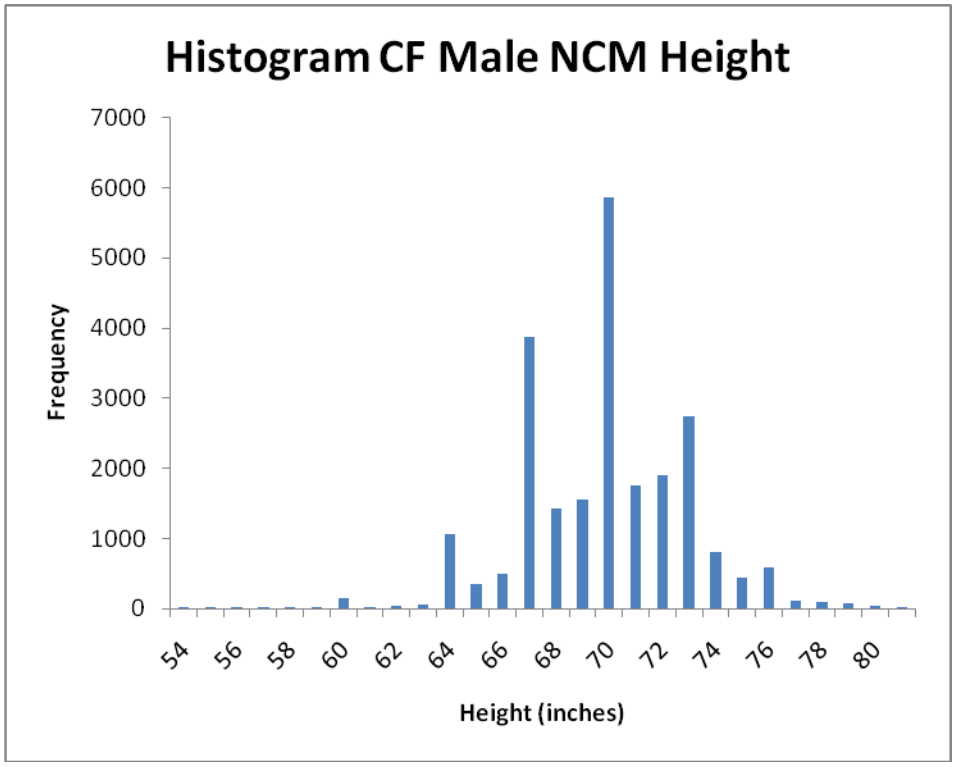
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure B-3: Histogram CF Male Officers Height



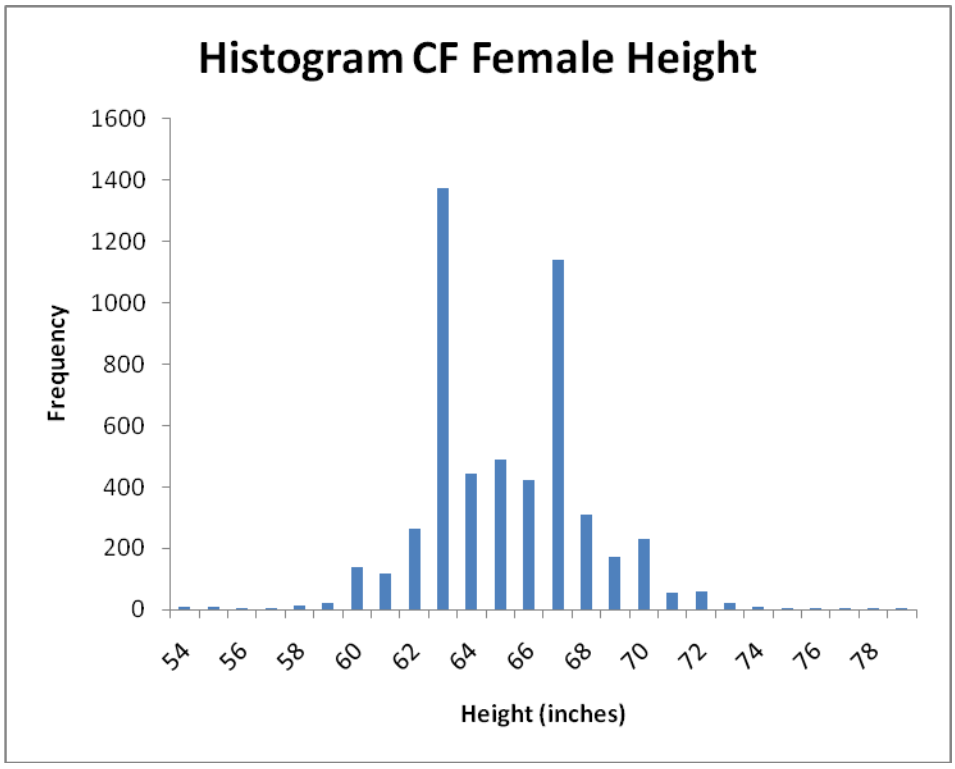
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure B-4: Histogram CF Male NCM Height



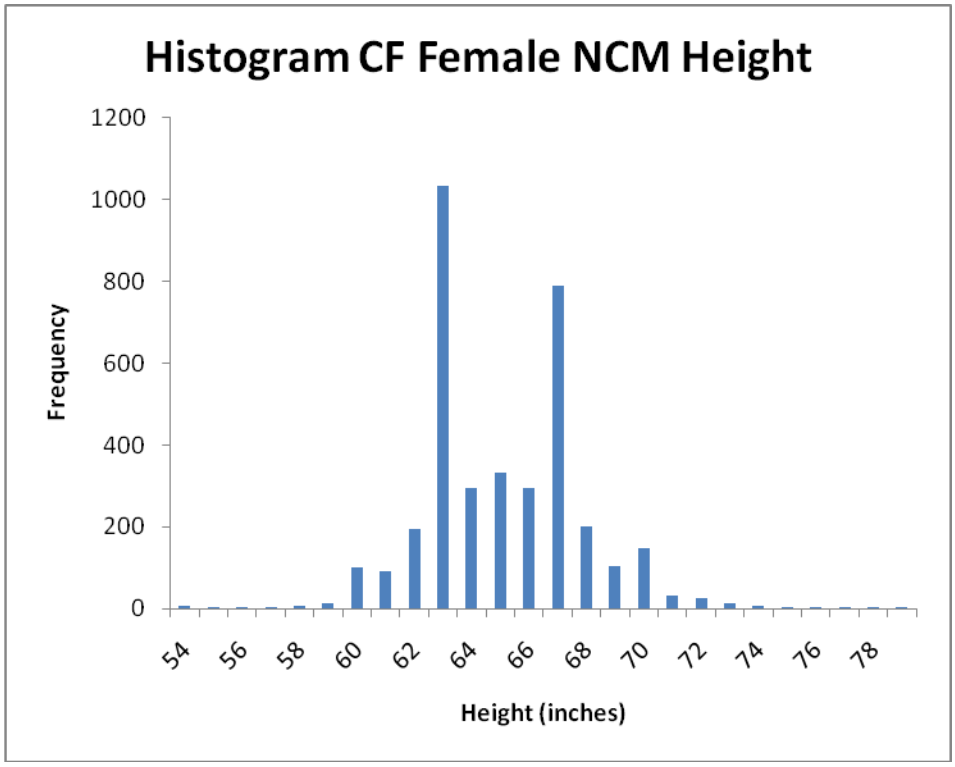
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure B-5: Histogram of the Canadian Forces Female Height



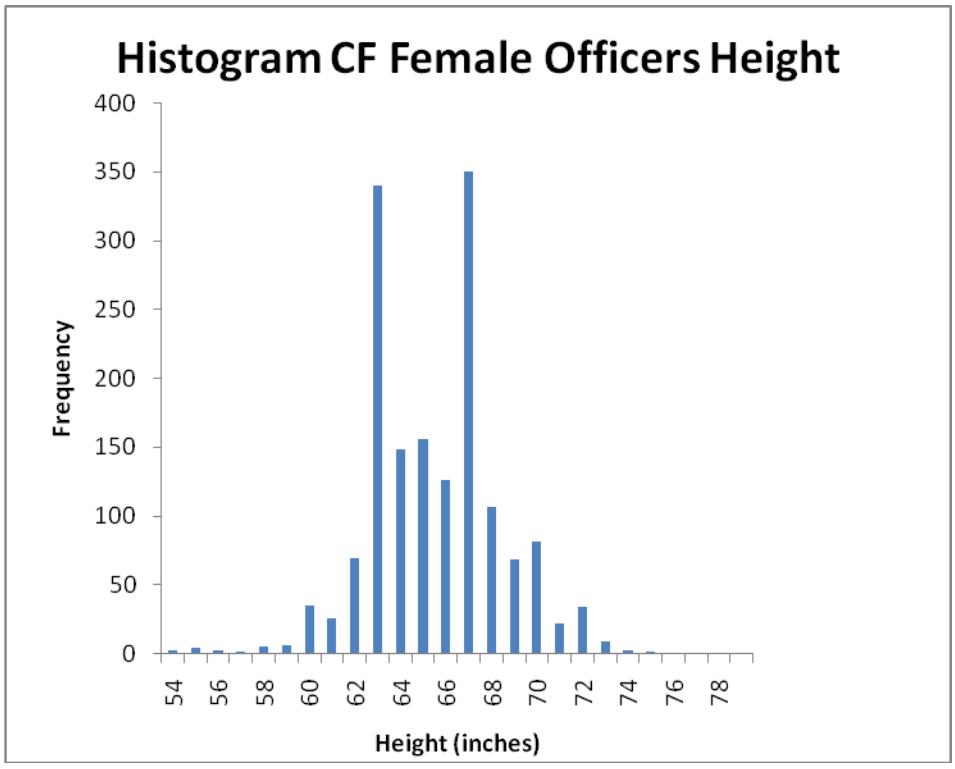
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure B-6: Histogram CF Female NCM Height



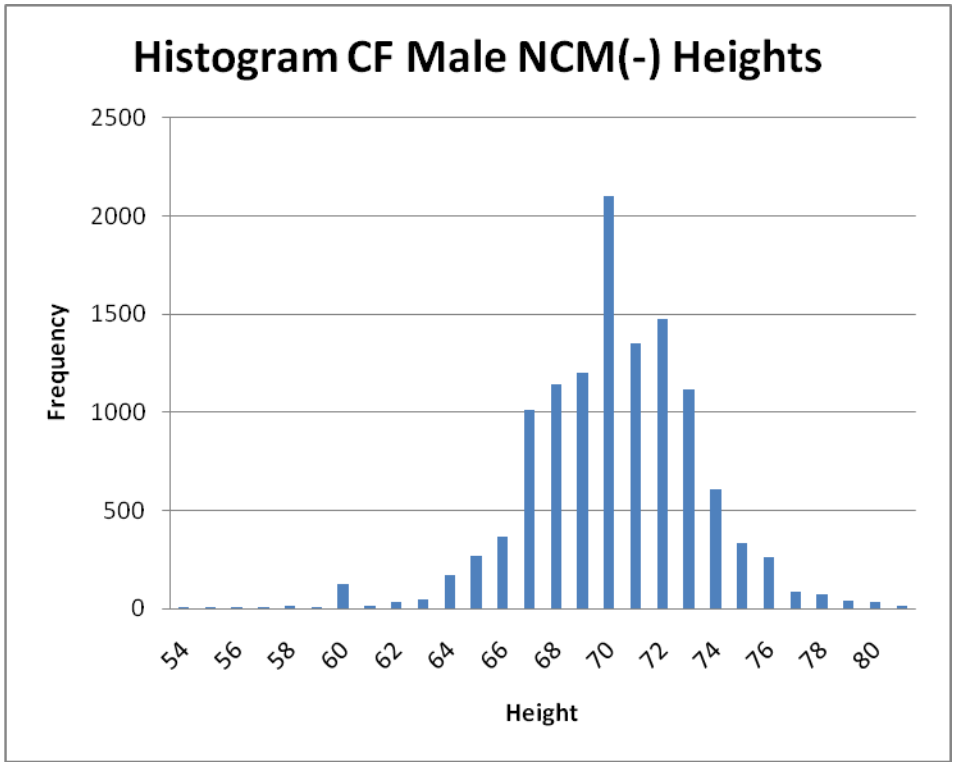
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure B-7: Histogram CF Female Officers height



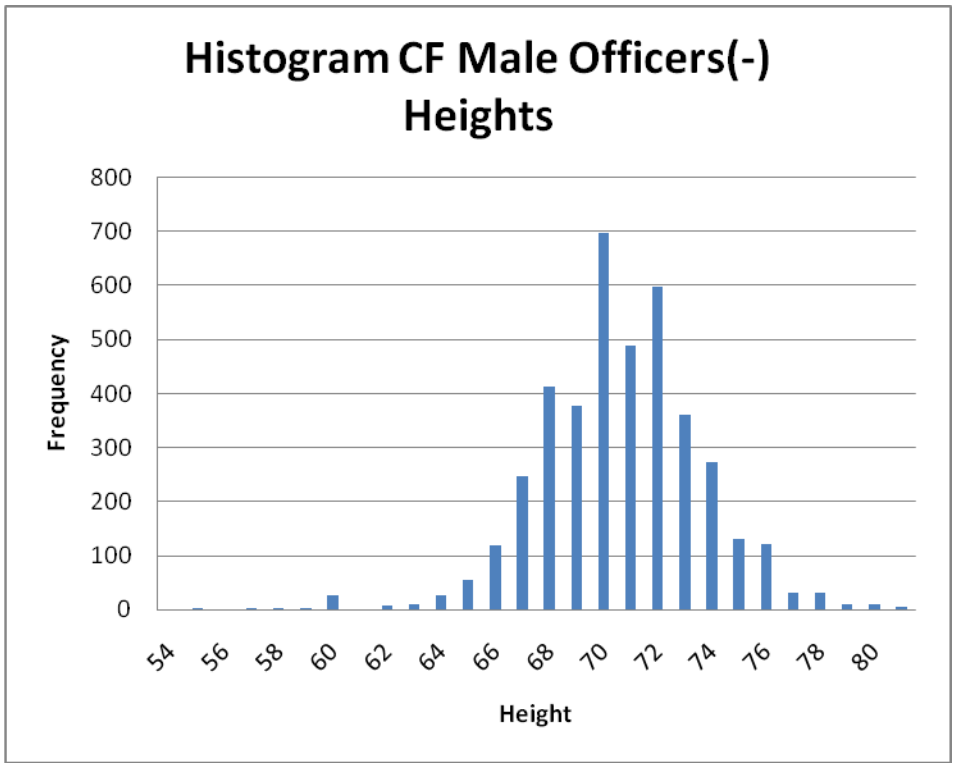
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure B-8: Histogram of CF Male NCM (-) Heights



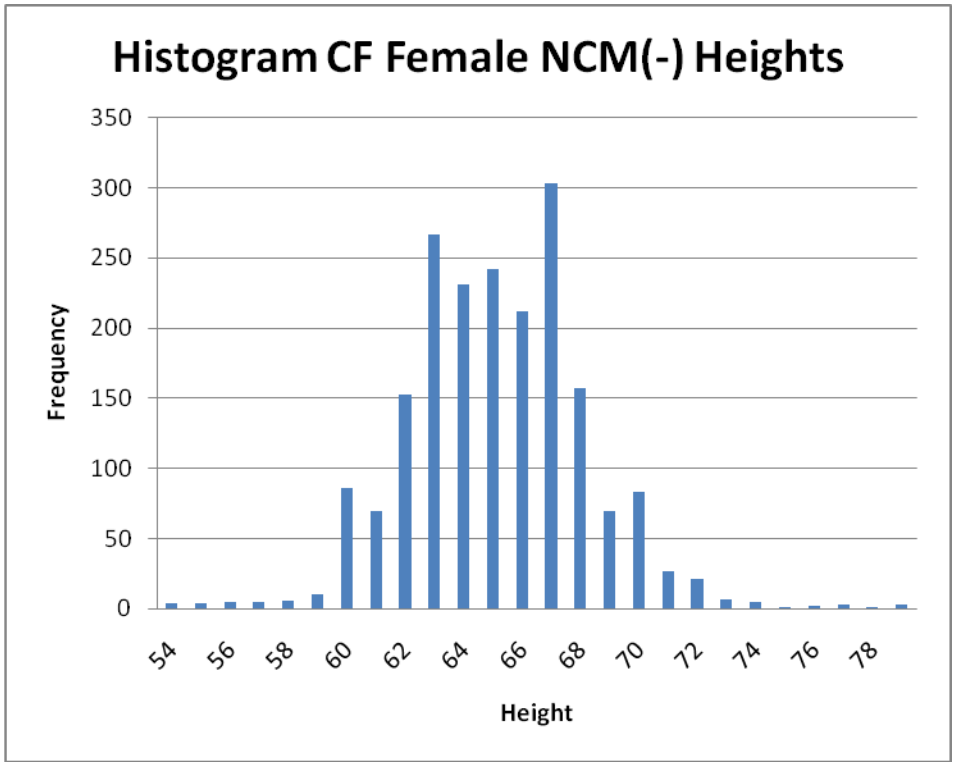
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure B-9: Histogram of CF Male Officers (-) Heights



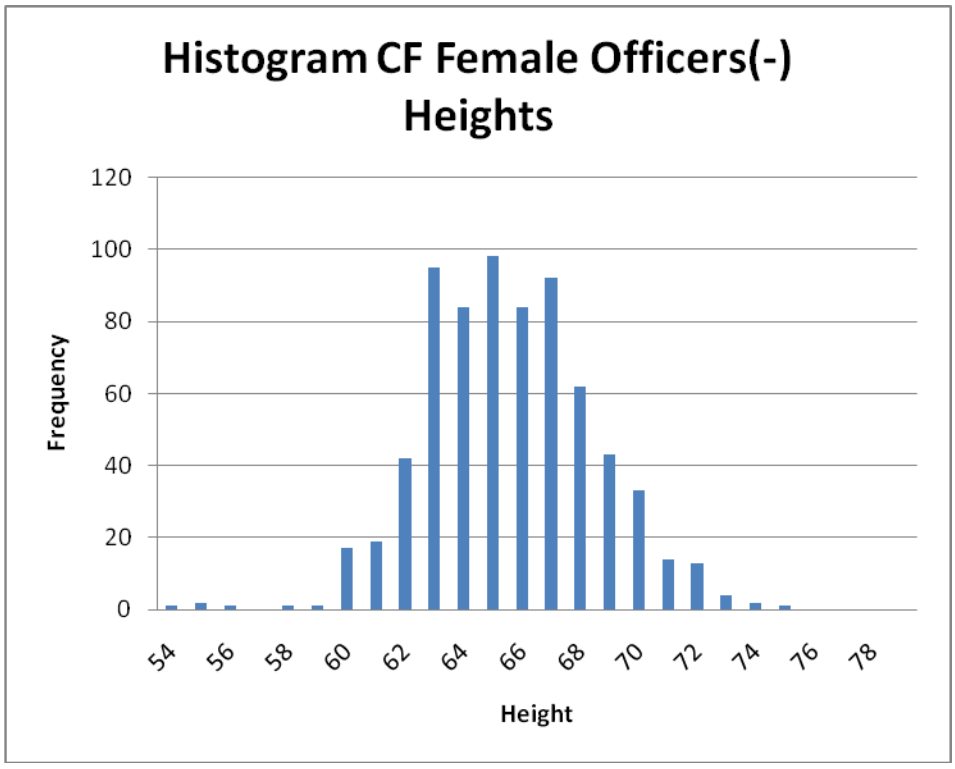
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure B-10: Histogram of CF Female NCM (-) Heights



Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure B-11: Histogram of CF Female Officers (-) Heights



Source: Logistik Unicorps dataset obtained on 28 September 2009

The next table shows for each rank and sub-group of the dataset: its number of entries, the average and the standard deviation. The Generals, all males in the database, are only present in the CF group as they are not considered to be part of a specific service anymore. The same could be said of the Senior CWO rank but they are differentiated only by their MOSID # which is why they are showing as a separate group in order to differentiate them from the services CWO. These numbers were used to create the height slope and R2 to show the graphic representations of rank versus height in each of the services or branches.

Table B-3: Height data (inches) of the Canadian Forces personnel divided by gender, elements and rank

		CF			Army			Navy			Air Force			Comms & Svcs			Support			Senior CWO		
Gender	Rank	Qty	Avg	SDp	Qty	Avg	SDp	Qty	Avg	SDp	Qty	Avg	SDp	Qty	Avg	SDp	Qty	Avg	SDp	Qty	Avg	SDp
Male	Pte	11566	69.44	2.99	6134	69.41	2.97	1149	69.63	3.02	1380	69.33	3.05	1445	69.49	3.05	1292	69.37	2.94			
	Cpl	5917	70.02	3.28	1719	70.22	3.11	761	69.92	3.36	1056	70.00	3.09	1357	70.02	3.47	1022	69.80	3.41			
	MCpl	2242	70.06	3.23	499	70.31	3.20	304	70.10	2.96	461	69.93	3.20	530	70.27	3.10	448	69.61	3.54			
	Sgt	1790	70.24	3.06	319	70.31	3.29	320	70.25	3.22	313	70.22	2.83	373	70.53	2.94	465	69.95	3.01			
	WO	1122	70.18	3.11	245	70.50	2.93	213	70.30	2.97	182	70.04	3.16	220	70.00	3.38	262	70.02	3.08			
	MWO	659	70.20	2.95	127	70.59	2.90	154	70.49	2.93	102	69.99	2.37	139	69.98	3.09	136	69.90	3.18			
	CWO	194	69.97	3.14	30	69.14	4.02	40	69.88	2.43	26	69.51	2.85	39	70.44	2.97	33	69.64	3.33	26	71.21	2.74
	OCdt-Lt	3566	69.92	3.15	938	70.06	3.14	487	70.07	3.23	920	69.92	2.98	346	69.58	3.28	382	69.75	3.34			
	Capt	2032	70.55	3.07	360	70.41	3.11	288	70.39	3.13	682	70.83	2.72	250	70.76	3.30	453	70.23	3.31			
	Maj	1339	70.46	2.89	274	70.52	2.67	215	70.27	3.43	389	70.70	2.64	183	70.60	2.76	278	70.10	3.01			
	LtCol	534	70.67	2.88	115	70.76	3.15	97	71.16	2.86	151	70.79	2.71	80	70.19	3.01	91	70.26	2.56			
	Col	139	70.48	2.33	41	70.64	2.31	28	71.13	2.49	37	69.97	2.08	14	70.96	2.02	19	69.84	2.40			
	Bgen	19	71.24	2.30																		
	Mgen	12	70.19	3.79																		
	Lgen	6	71.42	3.25																		
	Gen	1	72.00	0.00																		
Female	Pte	1740	64.87	2.41	152	64.71	2.35	136	64.88	2.37	174	64.75	2.51	179	65.43	2.71	1084	64.80	2.34			
	Cpl	983	65.00	3.05	33	65.47	3.81	63	65.34	2.78	83	64.80	2.94	160	65.49	3.13	644	64.85	3.01			
	MCpl	454	64.87	3.01	12	64.76	2.17	30	65.58	3.09	43	64.19	2.64	48	65.95	3.44	321	64.74	2.95			
	Sgt	363	65.40	3.10	3	64.25	2.61	20	65.53	3.74	21	65.52	3.12	37	65.89	3.33	282	65.33	3.01			
	WO	130	64.93	3.40	0	n/a	n/a	5	65.80	2.80	20	65.89	2.87	12	66.96	2.45	93	64.41	3.48			
	MWO	38	65.13	2.91	1	62.25	0.00	2	65.75	2.25	2	66.00	1.00	9	65.71	1.76	24	64.91	3.33			
	CWO	10	64.70	2.61	1	67.00	0.00	1	62.00	0.00	0	n/a	n/a	1	68.00	0.00	7	64.29	2.49			
	OCdt-Lt	885	65.41	2.85	62	65.52	2.55	94	65.47	2.46	146	65.44	2.52	68	65.57	2.32	387	65.07	2.87			
	Capt	470	65.51	3.04	12	65.47	3.30	42	66.23	3.54	96	66.02	2.75	44	65.47	3.04	274	65.21	3.00			
	Maj	195	65.33	2.64	11	65.59	2.92	13	65.38	2.59	20	65.82	2.82	25	64.75	2.53	126	65.35	2.58			
	LtCol	41	65.54	2.53	0	n/a	n/a	1	68.00	0.00	2	68.75	2.25	5	67.45	3.40	33	64.98	2.05			
	Col	3	64.00	3.27	0	n/a	n/a	0	n/a	n/a	0	n/a	n/a	0	n/a	n/a	3	64.00	3.27			

Source: Logistik Unicorps dataset obtained on 28 September 2009

ANNEX C – COMPARISON AND VALIDATION OF THE HEIGHT DATABASE

As previously described, the Logistik Unicorps dataset is composed of data entered by the user in order to create a personal profile used to recommend the best fit when ordering military clothes. All of the data is entered by the user and although the information is private and for the benefit of the user, there is always a bias when one self-reports his or her height as people seems to have a natural tendency to round-up their height. In order to better understand and confirm this bias in the CF, the author used a dataset obtained from Pierre Meunier who is based at Defence Research & Development Canada (DRDC) -Toronto and who is here formally thanked. In 1997, DRDC-Toronto created an anthropometric database which was used to evaluate the size requirements for future combat clothing acquisition (Clothe-the-Soldier project) and height was one of the many criteria formally measured. Table C-1 shows a summary of the measured dataset obtained.

Table C-1: Clothe-the Soldier anthropometric data summary

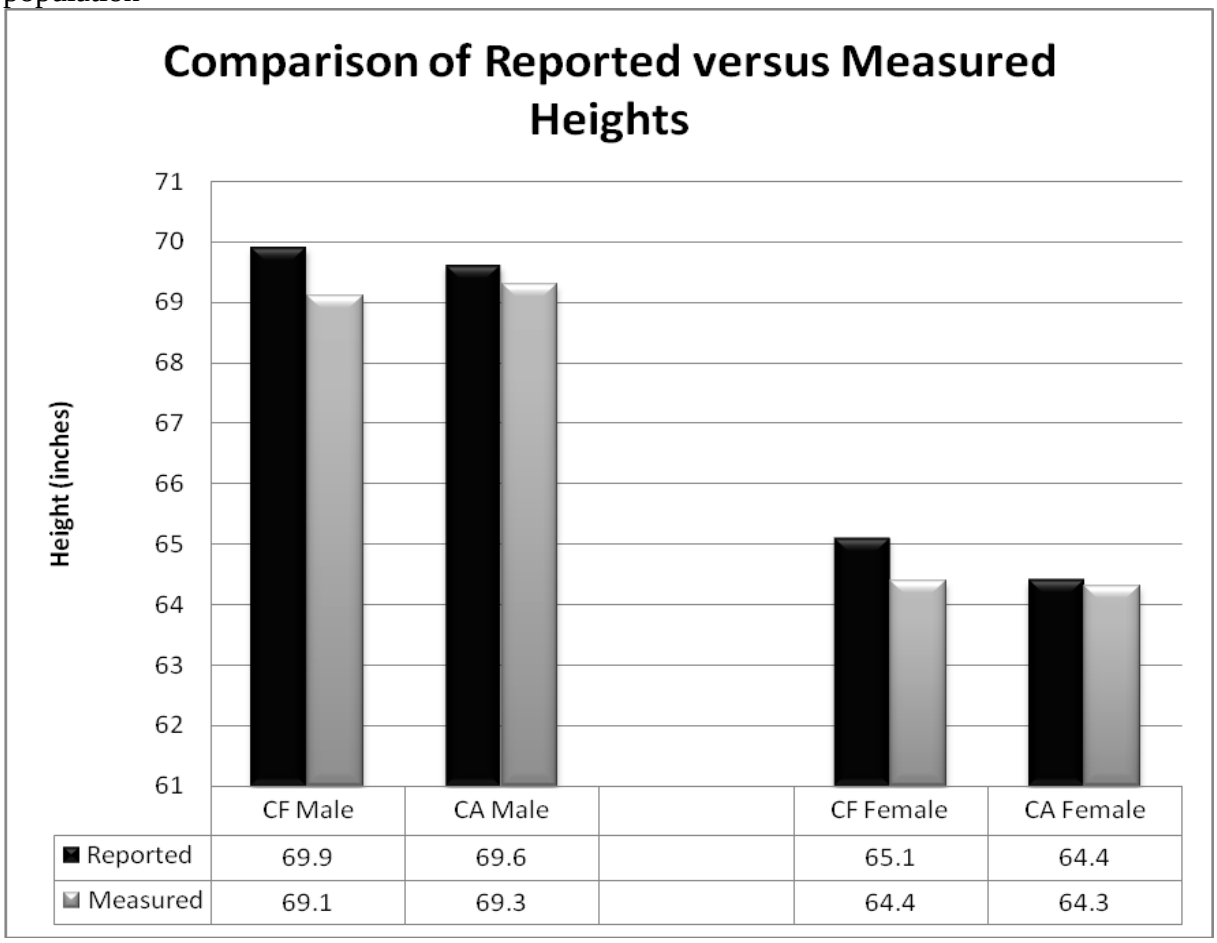
		All	NCM	Officers
Male	Qty	465	412	53
	Average	69.0966	69.14093	68.75204
	StdDev	2.581166	2.536808	2.879791
	Min	61.45669	61.45669	62.79528
	Max	76.69291	76.69291	74.44882
Female	Qty	243	208	35
	Average	64.39714	64.23418	65.36558
	StdDev	2.235895	2.160071	2.425777
	Min	58.18898	58.18898	60.15748
	Max	70.55118	70.55118	70

Source: Defence Research& Development Canada-Clothe-the-Soldier dataset created in 1997

An article published by Shields, Gorber and Tremblay in 2009, demonstrates that on average, Canadian men report their height to be 0.7 cm (0.3 inches) taller they actually are between the age of 25 and 44 years old (the difference increases with age as the human body "shrinks" and older people report their previous heights).[136] For women, the difference is smaller at 0.2 cm (0.1 inches). Putting together the results of the previous article with the average heights obtained from the Logistik Unicorps and the DRDC-Toronto dataset, Figure C-1 shows the measured delta and reported height of both male and female in the CF as well as comparisons of the obtained height with the Canadian population.

[136] Margot Shields, Sarah C. Gorber and Mark S. Tremblay, "Methodological Issues in Anthropometry: Self-Reported Versus Measured Height and Weight" Proceedings of Statistics Canada Symposium 2008, , http://www.statcan.gc.ca/pub/11-522-x/2008000/article/11002-eng.pdf (accessed 23 February 2010).

Figure C-1: Comparison of reported versus measured heights in both the CF and the Canadian population



Source: Based on Logistik Unicorps dataset (2009), Clothe-the Soldier anthropometric dataset (1997) and Statistics Canada dataset (2005)

What is immediately seen is that military members seem to be inflating their height more than the Canadian population. Some of the difference could be explained by the 12 years of difference between the DRDC (Toronto) and the Logistik Unicorps (2009) datasets but that alone is not likely to justify the larger differences of reported height for both men and women in the CF. Interestingly, this bias in question is very likely the main reason for the "peaks" observed in Figure B-2 to B-7 of the previous annex. People reporting their heights were rounding-up their height to the next convenient number (ex. CF Males rounding their height to 1.7m (67 inches) or

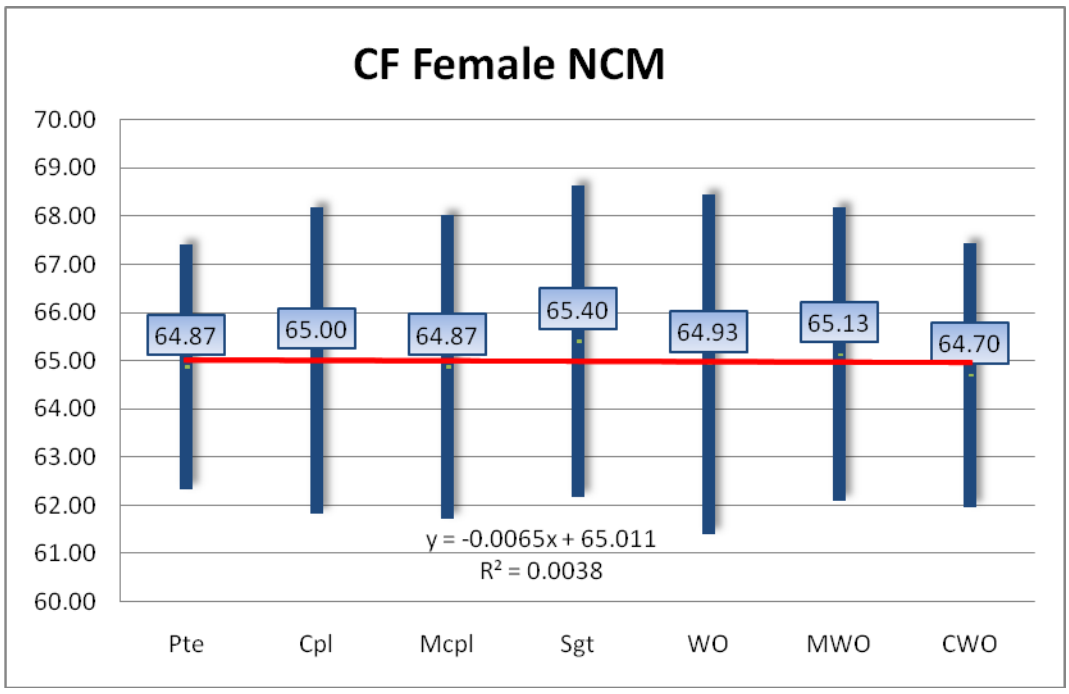
70 inches). Chapter 3 has demonstrated the many reasons why someone would like to appear taller and it might be why, military, like ordinary people want to believe they are taller and round-up their height.

ANNEX D – ADDITIONAL FEMALE GRAPHS

Because there is a lot less entries for female than male in the Logistik Unicorps dataset, sub-datasets quickly see their number of entries becoming very low to the point of statistical insignificance (the actual numbers are in Annex B). Furthermore, most of the obtained results or general conclusions on the female side of the house are in many ways similar to the male side but less pronounced.

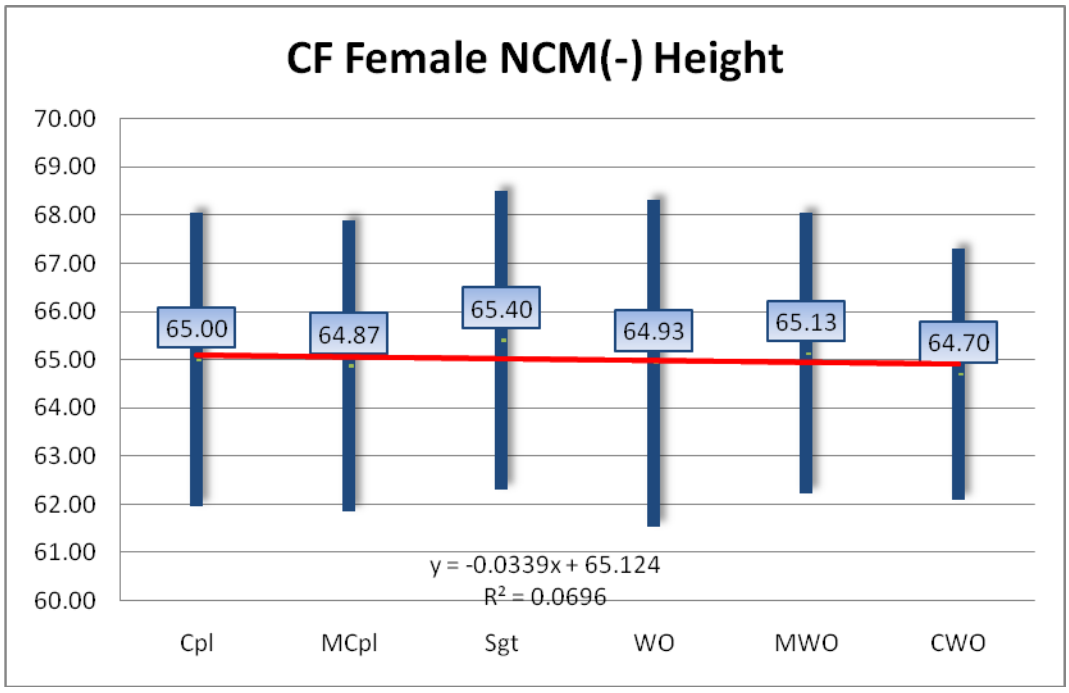
Below, Figures D-1 to D-4 show in a graphical way that at the CF level, both the female officers and female NCM heights are not related to rank. Figures D-5 and D-6 show the obtained slope and R2 for each of the CF Branches and although some of the results seem to indicate that some sub-datasets are showing a relationship between height and rank, they should not be considered significant. Only the CF as a whole and the Support group actually have a dataset large enough to draw generic conclusions and both figures D-5 and D-6 show that there is no graphical relationship between height and rank for the female in those two datasets. As for the other conclusions obtained from the female datasets, they can be read within the main body of text.

Figure D-1: Canadian Forces Female NCM Height-Rank visual relationship



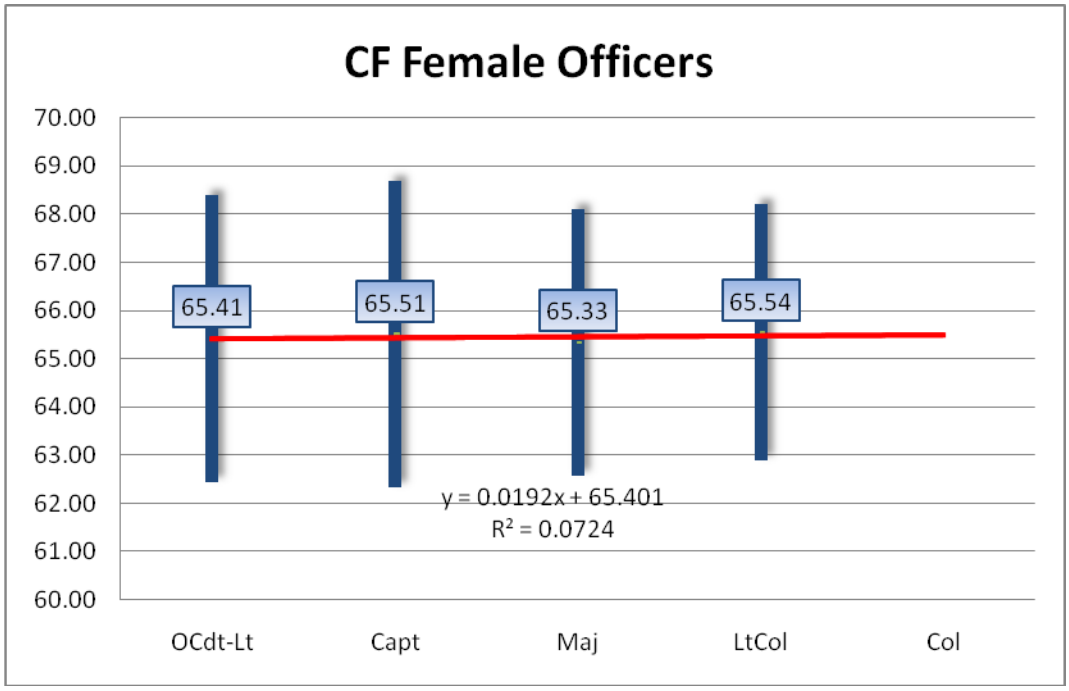
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure D-2: Canadian Forces Female NCM Height-Rank (- junior ranks) visual relationship



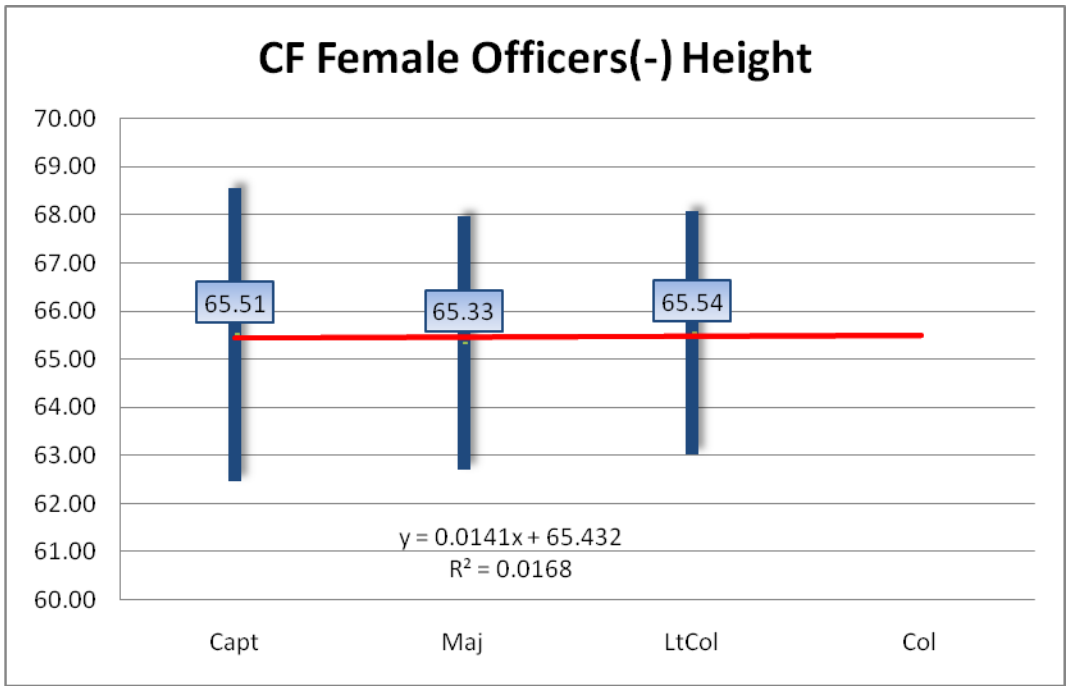
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure D-3: Canadian Forces Female Officers Height-Rank visual relationship



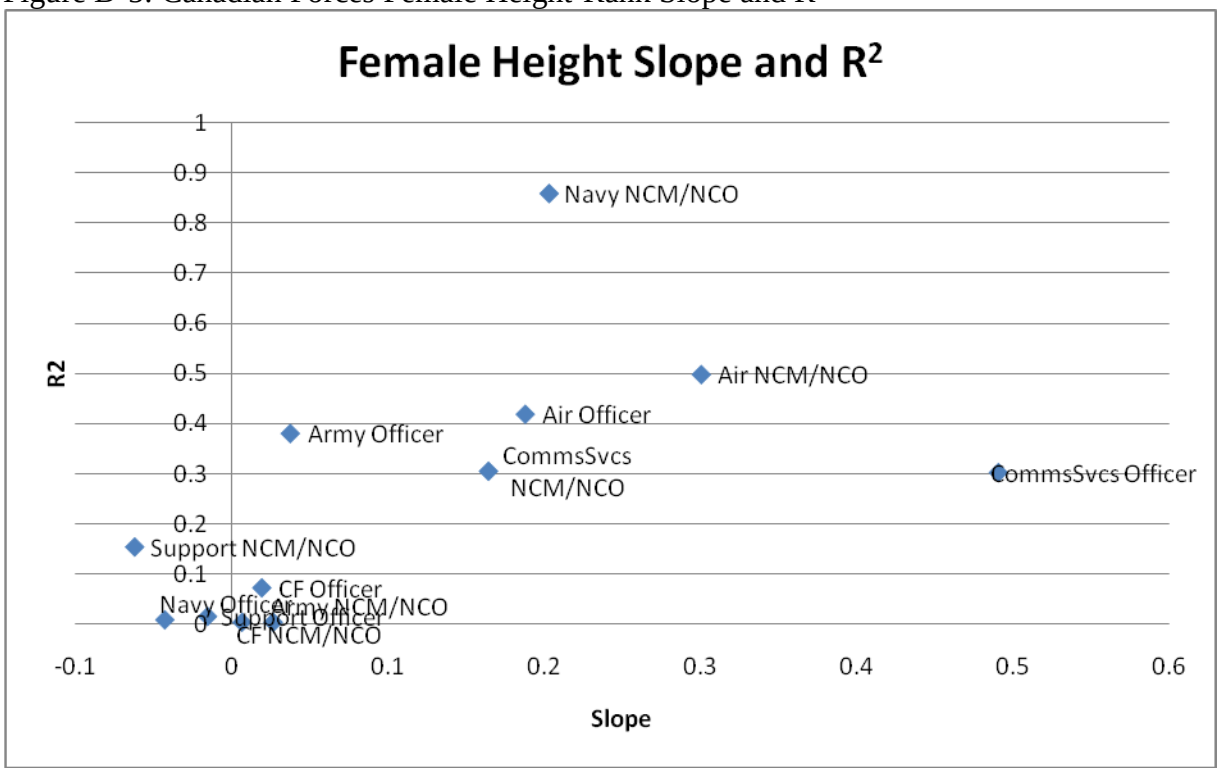
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure D-4: Canadian Forces Female Officers Height-Rank (- junior ranks) visual relationship



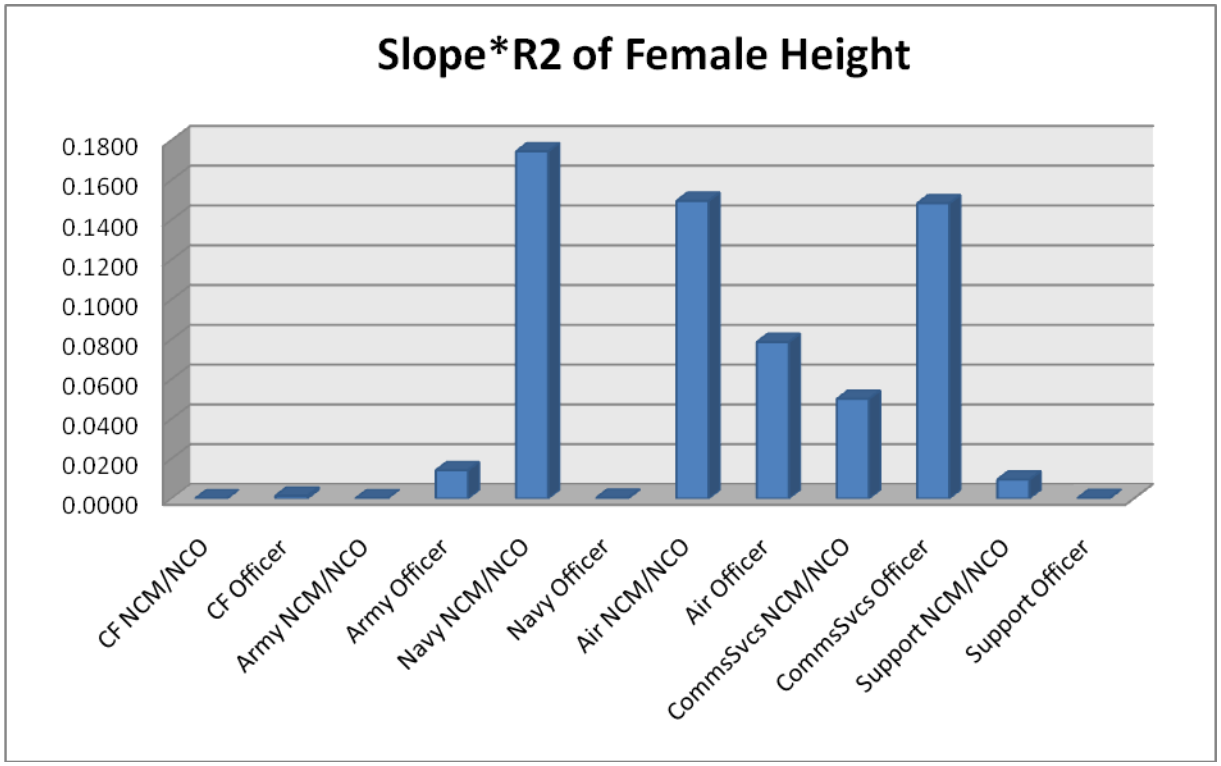
Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure D-5: Canadian Forces Female Height-Rank Slope and R^2



Source: Logistik Unicorps dataset obtained on 28 September 2009

Figure D-6: Canadian Forces Female Height-Rank Slope*R^2



Source: Logistik Unicorps dataset obtained on 28 September 2009