Profiling the Defenders

Carrie Gates
Faculty of Computer Science
Dalhousie University
Halifax, Nova Scotia
B3H 1W5 CANADA
gates@cs.dal.ca

Tara Whalen
Faculty of Computer Science
Dalhousie University
Halifax, Nova Scotia
B3H 1W5 CANADA
whalen at-sign cs.dal.ca

ABSTRACT

Psychological research in the security arena has focused on understanding the attacker, with little work done on understanding the defender. This paper presents a pilot study undertaken to determine if there are trends within the defender community, or if we represent a more diverse group with varying approaches to the problem. We surveyed 76 security professionals, using the Myers-Briggs Type Indicator as a tool to indicate similarities and differences in problem approaches. We find that the security community consists disproportionately of INTJs, and is especially disproportionate in the intuitive end of the intuitive-sensing dichotomy. This is not only in contrast to the general population of the United States, but also to engineers, software engineers and computer scientists (who are predominately ISTJ). We conclude that homogeneity amongst the defenders may not be a good strategy, and that further study be undertaken to determine the extent and effect of this homogeneity.

Keywords

security, psychological assessment, MBTI

1. INTRODUCTION

> Know the enemy and know yourself; in a hundred battles you will never be in peril. When you are ignorant of the enemy but know yourself, your chances of winning or losing are equal. If ignorant both of your enemy and of yourself, you are certain in every battle to be in peril.

Sun Tzu [29] first said these words circa 500 B.C., and they still hold true in today's computerized environment. However, outside of the technical analysis and response to security problems, security professionals have focused on understanding the attacker. Research has been done on understanding the insider threat [26], understanding cyberterrorism [24], and understanding hackers [23] and virus writers [11] in general. In contrast, little work has been done on understanding the defenders. And yet, without understanding ourselves as well as the attackers, we may leave ourselves vulnerable.

Studies conducted on technical professionals have shown prevalence of specific types in some job categories [3, 4, 5, 18, 27]. This suggests that different career fields may be dominated by particular personality types, and that there is a relationship between the type of work and the personality type. If this is true, then it is likely that security professionals are dominated by people with particular personality types. If you accept the hypothesis that a diversity of approaches to problem solving will benefit the security field, than such a dominance of any one particular personality type may provide an indication of a possible weakness in our defences.

This paper presents a pilot study aimed at determining if there is a predominant personality type among security professionals. The study consisted of a questionnaire that was completed by 76 security professionals. We used the Myers-Briggs Type Indicator®(MBTI)[1] as a tool to determine if there was a diversity of personality types. This tool was chosen due to the amount of information published about it, and because researchers have used it to examine other populations. While there are known to be some limitations to this instrument, it was felt to be appropriate for a pilot study to determine if further investigation of the hypothesis is warranted.

In Section 2 we provide background information on the MBTI tool, including its limitations. Section 3 presents our methodology, including the sampling procedure and resulting analysis, along with the limitations of the study. We discuss the results in Section 4, in particular in comparison to studies of similar populations, and provide some concluding remarks in Section 5.

2. THE MYERS-BRIGGS TYPE INDICATOR

2.1 Overview of the Myers-Briggs Type Instrument (MBTI)

The Center for Applications of Psychological Type (CAPT) [6], co-founded by Isabel Briggs Myers and Mary H. McCaulley,

[1] Myers-Briggs Type Indicator and MBTI are registered trademarks of Consulting Psychologists Press, Inc.

provides a summary of the MBTI on its website. The summary provided below draws heavily from this description, as well as from the writings of Peter Geyer [10].

The MBTI instrument was developed by Isabel Briggs Myers and Katharine Cook Briggs, having been founded on the work of C. G. Jung. Jung developed theories of psychological type that focused primarily on perception and judgment. He described mental functioning through a set of categories: extraversion and introversion; sensing and intuition; and thinking and feeling. Briggs Myers and Briggs adapted Jung's typology: they added another dimension–perceiving and judging–and created a psychological testing instrument, the MBTI. In brief, the MBTI instrument places these psychological aspects in opposing pairs and creates four independent indices along which people's preferences lie. The typology sets up pairs that lie on opposite ends of a scale, as follows:

Extroversion-Introversion (EI): The EI index is strongly based on Jung's work, and describes how people focus their attention. Extroverts tend to be focused on the outer environment around them (people and objects); they prefer to direct their energies toward interaction with the external world. In contrast, introverts tend to direct their focus inwardly, preferring to concentrate on ideas and concepts.

Sensing-Intuition (SN): The SN index is intended to show how people primarily perceive information. Those who rely predominantly on sensing will draw from their five senses, focusing on observable facts or phenomena. Those who rely more on intuition will go beyond sensory details and focus on the meanings and possibilities of this input. Basically, sensing refers to the "here and now", while intuition refers to "the big picture."

Thinking-Feeling (TF): The TF index is intended to show how people primarily make judgments. A "thinking" person tends to make decisions based on impartial facts, and is concerned with logical consequences when considering which action to take. A "feeling" person tends to make decisions based on their individual emotions and responses, and is concerned with personal and social values when considering which action to make. (Of course people have both thinking and feeling components of their personality; this aspect refers only to a dominant approach to decision-making.)

Judgment-Perception (JP): The JP index was added to Jung's typology, and is concerned with how people interact in general with the outer world (that is, when they are operating in an extroverted mode). This index is related to (although not dependent on) the TF and SN axes: those who rely more on judgment use a thinking or feeling (TF) process, while those who rely more on perception use a sensing or intuition (SN) process.

People using the MBTI instrument answer a series of questions to determine where their preferences lie on these scales. The result is one of sixteen types that show dominant tendencies on each axis (for example, ESTP or INFJ).

Note that according to the MBTI theory, the preference expressed is indicative of a dominant tendency: this means only that in most situations, this is the more common preference. Every person can and will operate in several places on the continuum between, for example, extroversion and introversion. As Quenk states, "Bear in mind that the instrument is labeled an indicator rather than a test not only to discourage the idea that is has right and wrong answers, but also because it is meant to indicate which type is *likely* to best fit the respondent." [22]

2.2 Limitations and Caveats of MBTI

The MBTI instrument is designed to measure a very small fraction of the human personality; it is restricted only to aspects of perception and judgment. The CAPT website, in a section on ethical use, very clearly advises MBTI administrators to interpret the results conservatively, because "Type does not reflect an individual's ability, intelligence, likelihood of success, emotions, or normalcy. Type is one important component of the complex human personality." [7]. Despite this caveat, MBTI is widely misused; in particular, it is misapplied in career counseling. According to Quenk [22, p. 72]:

> A common error made by laypeople, professionals, and critics of the MBTI alike is to assume that the types who predominate in an endeavor are therefore more suited for it or "better" at it. In fact, type theory predicts that individuals of different types will be differentially *attracted* to different occupations and work characteristics such as managerial and leadership roles. The theory does not predict competence of satisfaction, nor is there any expectation or empirical evidence that a rare type in a position will be "unsuited for it," less competent, or less satisfied. Rather, he or she is likely to be different from the predominant type in terms of the way the job is done, particular motivations, nature of satisfactions, and the like.

Another limitation of MBTI, as with other self-reporting psychological testing instruments, is that it requires honesty on the part of the respondent. If a person is unaware of their own true preferences, or gives untrue answers in order to present a particular image (e.g., would rather be an extrovert than an introvert), then the test will not given an accurate indication of their true preferences. This effect cannot be eliminated, only minimized. (An instrument such as the Paulhus Deception Scales [9] can be used to indicate accuracy of a subject's responses; we did not use this test in our study.) As well, test results can be affected by a number of factors, such as reading comprehension and chemical addiction.

The MBTI instrument has some other drawbacks beyond misapplication and self-reporting limitations. There are aspects of the test itself that are problematic; a concise overview of these can be found in an analysis by Pittenger [21]. The first issue is that of its statistical structure. A person who is very close to the center of one scale (say, thinking-feeling) may test as a "T", but is closer in temperament to a person who is slightly towards "F" than to one who is extremely close to the "T" end of the scale. However, two people are placed in the same category ("T") even if one has a moderate "T" score and one has an extreme "T" score. (Note that the latest versions of the MBTI provide a continuous dimensional scoring system—that is, they show exactly where scores lie on each axis—but the actual analysis of the test results still uses the dichotomous types. [2]) Statistically, if the MBTI typology is correct, and the types are truly discrete, then there should be a bimodal distribution of scores, with little or no overlap of the curves. There is no clear evidence that this bimodal distribution exists; one recent study examined the question in detail and could find no support for such a claim [2]. Although the authors state that this result does not *disprove* the validity of the MBTI model, it should suggest caution in its use, as its statistical soundness has not been verified.

A second problem with the MBTI is that its test-retest reliability has not been consistently confirmed. If a person takes the same test after some period of time (e.g., a few weeks), then a reliable test would give the same result again. There has been conflicting evidence as to test-retest reliability of the MBTI. (Note that the MBTI instrument has changed over time, so some research results are based on obsolete versions of the indicator.) For example, a 1979 study by Howes and Carskadon found poor test-retest reliability over a 5-week interval [15]. However, more recent research was supportive of reliability, including a 2001 study by O'Toole and Torabi (0.78-0.87 over 5-week interval) [20]. A 1992 study by Johnson [16] also supported test-retest reliability over a 30-month interval: 0.79-0.83 for the EI, SN, and JP axes, and 0.62 for the TF axes. Johnson indicates that the TF scale is the most variable, which suggests that scores on this axis may be the most difficult to analyze reliably.

Despite the limitations of the MBTI instrument, we decided to use it in this profiling study. The primary reason was that this tool is in widespread use; if we wished to compare security defenders to another population (such as hackers), then we were restricted to comparing test results from both groups. The only such psychological testing results that were available to us were gathered through the MBTI instrument. Thus we have proceeded to collect data and perform a preliminary analysis; however, we acknowledge—and stress to the reader—that the underlying testing instrument has flaws that reduce the strength of our results.

3. METHOD

3.1 Sampling Procedure

We decided to conduct a short survey of security personnel for our study. In order to gather responses from a sufficient number of people in this narrow field, we were required to gather participants from outside our own geographic area. Because this population tends to have a strong online presence, we determined that online recruitment would be suitable for our needs. Because we were limited to interacting with our participants online, we also needed an online MBTI instrument (for those who did not know their type). We also required a free test, as we did not have the financial resources to pay for tests for a large number of subjects. Finding a free online testing tool proved somewhat difficult: the official MBTI instrument is not available online, so we had to find an alternative testing tool. One possibility was the Keirsey Temperament Sorter II (KTS-II) [1]; the online version of the KTS-II has been shown to have strong correlation with the MBTI instrument [17], and thus would make a suitable substitute. Unfortunately, the online KTS-II provides only a partial report for free (only two of the four indices). We found a variation on the KTS-II at the Humanmetrics website (`http://www.humanmetrics.com/cgi-win/JTypes1.htm`). This is a 72-question, forced-choice questionnaire, with a choice of yes/no answers. (A sample question: "After prolonged socializing you feel you need to get away and be alone: yes/no".) It is important to note that this test is not the same as the KTS-II, and thus measures of concurrent validity of the KTS-II cannot be applied to the Humanmetrics test. However, we found that this tool was sufficient for exploratory purposes. If a participant already knew their MBTI type from an official test, then we asked them to indicate this fact and fill in their type on the survey. (Because we concluded that the most accurate tool was the official MBTI instrument, we did not want to supplant this data with the online results; in addition, we did not want our participants to have to do more work than necessary to complete the survey.)

In order to perform a small amount of statistical analysis, we added two demographic questions to the survey. First, we wanted to know if there were any gender-based differences. Second, we wanted to know if the type of security work—theoretical or practical—had any significance on our findings, so we asked whether the respondents considered themselves to be a researcher or a practitioner. (Selecting "both" was a valid response.)

After constructing the survey, we solicited participants through several forums and lists of security personnel. Note that

Source of Respondents	Group Size
security colleagues/associates (personally-generated list)	80
hcisec mailing list (yahoo)	92
unisog mailing list (sans)	1400
orkut network security community	1500
other (e.g., smaller mailing lists, referrals from colleagues)	N/A
total	~3000

Table 1: List of sources for respondents, and the approximate size of those sources as of March 2004.

there may be some overlap among membership of these lists, so the total may actually be smaller than the sum of the individual lists. There is also no guarantee that the request was read by all the members of these lists, so the total is only intended to be an indication of the size of pool from which we drew responses. (If domain names are any indication of geographic location, then we appear to have received survey responses from several countries, including Canada, the US, the UK, Australia, New Zealand, Brazil, Portugal, Slovakia, Denmark, Germany, and the Netherlands.)

ISTJ $n = 4$ (5.3%) $I = 0.34^{*}$ $R = 0.22^{**}$ $T = 0.38^{*}$	ISFJ $n = 4$ (5.3%) $I = 0.46$ $R = 2.65$ $T = 0.73$	INFJ $n = 5$ (6.6%) $I = 2.54$ $R = 6.60$ $T = 7.33^{***}$	INTJ $n = 26$ (34.2%) $I = 9.77^{***}$ $R = 4.88^{***}$ $T = 14.87^{***}$
ISTP $n = 1$ (1.3%) $I = 0.20$ $R = 0.16$ $T = 0.15^{*}$	ISFP $n = 0$ (0.0%) $I = 0.00$ $R = 0.00$ $T = 0.00$	INFP $n = 1$ (1.3%) $I = 0.30$ $R = 0.65$ $T = 0.42$	INTP $n = 12$ (15.8%) $I = 3.04^{***}$ $R = 1.98$ $T = 6.58^{***}$
ESTP $n = 0$ (0.0%) $I = 0.00$ $R = 0.00^{*}$ $T = 0.00^{*}$	ESFP $n = 0$ (0.0%) $I = 0.00$ $R = 0.00$ $T = 0.00$	ENFP $n = 2$ (2.6%) $I = 0.41$ $R = 0.87$ $T = 0.62$	ENTP $n = 5$ (6.6%) $I = 1.40$ $R = 0.94$ $T = 1.61$
ESTJ $n = 0$ (0.0%) $I = 0.00^{**}$ $R = 0.00^{**}$ $T = 0.00^{***}$	ESFJ $n = 2$ (2.6%) $I = 0.27$ $R = 0.65$ $T = 0.29$	ENFJ $n = 6$ (7.9%) $I = 3.16^{*}$ $R = 7.90$ $T = 5.27^{***}$	ENTJ $n = 8$ (10.5%) $I = 3.75^{***}$ $R = 2.63$ $T = 2.44^{*}$

Table 2: Distributions of type in security practitioners. $N = 76$ The values for I indicate the under- or over-representation of the type when compared against the population of the United States, while R indicate the same when compared against a sample of software engineers and T indicate the same when compared against a sample of police officers. * indicates $p - value < 0.05$ when using a 2×2 table comparing the population of those with the type versus those that do not have that type, versus the sample population and the comparison population. ** indicates $p - value < 0.01$ and * indicates $p - value < 0.001$.**

3.2 Analysis

There were 79 responses to the survey, however 3 data points were removed due to incomplete information. The result was 76 subjects, 20 females (26%) and 56 males. (This is fairly representative of the percentage of women employed in a computer/information science job in the U.S.: 26% [19].)

There were 53 subjects who self-described themselves as security practitioners (16 females and 37 males), 21 subjects who described themselves as security researchers (4 females and 17 males) and 2 subjects who selected both categories (both male).

Of the 76 subjects, 25 had previously had the Myers-Briggs Type Indicator (MBTI) professionally administered, whereas 51 had not and so used the on-line version supplied in the study. Of the 16 MBTI types, there was representation across 12 of them, with ESFP, ESTP, ESTJ and ISFP not represented at all. The distribution of the types is presented in Table 2. The values presented here are ± 9% with a 90% confidence interval (due to the small sample size of 76).

Table 2 presents the distribution of type in security practitioners. The values for I, R and T represent the ratio of the observed frequencies to the expected frequencies, which is called the self-selection ratio or index. The values for I indicate the under- or over-representation of the type when compared against the population of the United States as determined by Hammer and Mitchell [13]. Similarly, the values for R indicate the under- or over-representation of the type when compared against a sample of software engineers, as described by Capretz [5]. The values for T indicate the under- or over-representation of the type when compared against a sample of police veterans and recruits, as described by Hanewicz [14]. We compare here against both police officers and software engineers in the belief that security practitioners may have some commonalities with these two groups, the first due to their investigative nature and the second due to their technical nature.

The study by Hammer and Mitchell [13] consisted of 1267 adults (aged 18 and over), and is considered to be representative of the general United States population. It closely resembles the 1990 U.S. Census in terms of the numbers of women and men across various races (white, black, American Indian, Eskimo or Aleut, Asian or Pacific Islander, and other). However, the education level of those who were sampled appears to be slightly higher than the general population, and may have resulted in a slight over-representation of introverts. As well, not all our respondents were from the U.S. (judging by email addresses), so the populations are not exactly equivalent.

In contrast, the study by Capretz [5] sampled 100 software engineers, including both students (upper-level undergraduate and graduate) and professionals (working for either the government or software companies). Of these 100 subjects, 80 were male and 20 were female. No further demographic information was provided. The study by Hanewicz [14] sampled 1282 police officers, both veterans and recruits, in both Michigan (439 samples) and Florida (843 samples).

Tables 3 and 4 present the same comparisons of security practitioners to the United States general population, to a population of software engineers, and to a population of police officers. However, Table 3 breaks the results down by each individual dichotomy (e.g. EI, NS, TF, and JP). This table shows that security practitioners are significantly different from the general population of the United States across all four dichotomies, and from police officers across three of the four dichotomies — all except the thinking/feeling dichotomy. Security practitioners, perhaps not surprisingly, are less different from software engineers. However there are still very significant differences on the intuiting-sensing dichotomy.

Table 4 divides the MBTI results into each possibly pair of dichotomous values. For example, combining the EI and SJ

E	$n = 23$	(30%)	$I = 0.65^{**}$	$R = 0.71$	$T = 0.54^{***}$
I	$n = 53$	(70%)	$I = 1.30^{**}$	$R = 1.22$	$T = 1.59^{***}$
S	$n = 11$	(15%)	$I = 0.21^{***}$	$R = 0.22^{***}$	$T = 0.19^{***}$
N	$n = 65$	(85%)	$I = 2.68^{***}$	$R = 2.59^{***}$	$T = 3.77^{***}$
T	$n = 56$	(74%)	$I = 1.39^{***}$	$R = 0.91$	$T = 1.16$
F	$n = 20$	(26%)	$I = 0.56^{***}$	$R = 1.38$	$T = 0.73$
J	$n = 55$	(72%)	$I = 1.25^{*}$	$R = 1.25$	$T = 1.20^{*}$
P	$n = 21$	(28%)	$I = 0.66^{*}$	$R = 0.66$	$T = 0.69^{*}$

Table 3: The number and percent of the population that expresses each of the dichotomous preferences. This has also been compared against the general population of the United States (values for I), against a population of software engineers (values for R), and against a population of police officers (values for T). * indicates $p < 0.05$, ** indicates $p < 0.01$ and * indicates $p < 0.001$.**

dichotomies results in four possible values: ES, EJ, IS and IJ. This table reflects many of the differences highlighted in Table 3, showing significant differences from the general population (and from police officers and software engineers) in any pair that included the intuiting-sensing dichotomy. It also indicates that there are more IT and IJ individuals in the security community than in both the general population and amongst police officers, while FP is under-represented.

IJ	$n = 39$	(51%)	$I = 1.55^{**}$	$R = 1.51^{*}$	$T = 2.09^{***}$
IP	$n = 14$	(18%)	$I = 0.90$	$R = 0.80$	$T = 0.95$
EP	$n = 7$	(9%)	$I = 0.43^{*}$	$R = 0.48$	$T = 0.45^{*}$
EJ	$n = 16$	(21%)	$I = 0.85$	$R = 0.88$	$T = 0.59^{*}$
ST	$n = 5$	(7%)	$I = 0.18^{***}$	$R = 0.12^{***}$	$T = 0.13^{***}$
SF	$n = 6$	(8%)	$I = 0.25^{***}$	$R = 0.66$	$T = 0.30^{***}$
NF	$n = 14$	(18%)	$I = 1.17$	$R = 2.63^{*}$	$T = 1.92^{*}$
NT	$n = 51$	(67%)	$I = 4.17^{***}$	$R = 2.58^{***}$	$T = 5.12^{***}$
SJ	$n = 10$	(13%)	$I = 0.28^{***}$	$R = 0.29^{***}$	$T = 0.26^{***}$
SP	$n = 1$	(1%)	$I = 0.06^{***}$	$R = 0.06^{***}$	$T = 0.05^{***}$
NP	$n = 20$	(26%)	$I = 1.28$	$R = 1.32$	$T = 1.92^{**}$
NJ	$n = 45$	(59%)	$I = 5.19^{***}$	$R = 4.55^{***}$	$T = 6.58^{***}$
TJ	$n = 38$	(50%)	$I = 1.57^{**}$	$R = 1.00$	$T = 1.21$
TP	$n = 18$	(24%)	$I = 1.12$	$R = 0.77$	$T = 1.05$
FP	$n = 3$	(4%)	$I = 0.19^{***}$	$R = 0.36$	$T = 0.23^{**}$
FJ	$n = 17$	(22%)	$I = 0.85$	$R = 2.80^{*}$	$T = 1.19$
IN	$n = 44$	(58%)	$I = 3.71^{***}$	$R = 3.22^{***}$	$T = 6.66^{***}$
EN	$n = 21$	(28%)	$I = 1.69^{*}$	$R = 1.84$	$T = 1.97^{**}$
IS	$n = 9$	(12%)	$I = 0.31^{***}$	$R = 0.30^{***}$	$T = 0.34^{***}$
ES	$n = 2$	(3%)	$I = 0.09^{***}$	$R = 0.09^{***}$	$T = 0.06^{***}$
ET	$n = 13$	(17%)	$I = 0.77$	$R = 0.50^{*}$	$T = 0.47^{***}$
EF	$n = 10$	(13%)	$I = 0.55^{*}$	$R = 1.47$	$T = 0.68$
IF	$n = 10$	(13%)	$I = 0.57$	$R = 1.32$	$T = 0.79$
IT	$n = 43$	(57%)	$I = 1.84^{***}$	$R = 1.20$	$T = 2.09^{***}$

Table 4: The number and percent of the population that expresses each of the pairs and temperaments. This has also been compared against the general population of the United States (values for I), against a population of software engineers (values for R), and against a population of police officers (values for T). * indicates $p < 0.05$, ** indicates $p < 0.01$ and * indicates $p < 0.001$.**

The independence between each dichotomous pair was also tested, using a 2×2 table and the χ^2 test. For example, the extravert-introvert dichotomy was compared to the judging-perceiving dichotomy to determine if the two characteristics were independent. It was found that all of the dichotomies are independent of each other, however two particular pairs warrant further investigation. The dichotomy sensing-intuiting versus thinking-feeling had a $p - value = 0.05374$, while extravert-introvert versus thinking-feeling had a $p - value = 0.05061$. Both of these are close to values where the NULL hypothesis (the hypothesis that the pairs are independent) would be rejected, and so should be studied using a larger sample population.

	female	male	researcher	practitioner
E	$n = 4$	$n = 19$	$n = 10$	$n = 13$
I	$n = 16$	$n = 37$	$n = 11$	$n = 40$
S	$n = 9$	$n = 2$	$n = 4$	$n = 7$
N	$n = 11$	$n = 54$	$n = 17$	$n = 46$
T	$n = 12$	$n = 44$	$n = 15$	$n = 40$
F	$n = 8$	$n = 12$	$n = 6$	$n = 13$
J	$n = 18$	$n = 37$	$n = 17$	$n = 37$
P	$n = 2$	$n = 19$	$n = 4$	$n = 16$

Table 5: The number of males, females, practitioners and researchers that exhibit each of the dichotomous preferences.

Table 5 shows the numbers of men and women who presented each of the dichotomous preferences, as well as the number of researchers and practitioners. Comparing the researchers to practitioners, there were no significant differences. However, when comparing men to women, there was a significant difference in the number of women who expressed sensing versus intuiting, compared to men. Women were much more likely to express sensing than men were ($p < 0.001$).

When the dichotomous preferences for the female subjects were compared against the values obtained by Hammer and Mitchell for a representative sample of women in the US [13], women security professionals exhibited significant differences on three of the characteristics: extraversion-introversion ($p < 0.05$), sensing-intuition ($p < 0.05$), and judging-perception ($p < 0.05$). In contrast, when the male subjects were compared against a male sample from the general population of the US, only one scale indicated significant differences: sensing-intuition ($p < 0.001$).

It is interesting to note that the sensing-intuition dichotomy is very prominent in its deviance from population norms. For example, while women are significantly better represented in the sensing preference than are men, they are still significantly less represented here than in the population at large (where 71.4% of women typically express a preference for sensing). Male security professionals express an even greater preference for intuiting, with $p = 2.2 \times 10^{-16}$ (where 64.4% of the general male population prefers sensing). Given that women in general express a greater preference for sensing than men (71.4% versus 64.4% of the general population), this may explain why significantly more women indicated a preference for sensing in our sample population.

3.3 Limitations of the Study

One of the limitations of this study is the sample size of 76, which results in values that have a wide margin of error with a low level of confidence. Ideally, a second study into MBTI types would include 384 subjects, resulting in a proportion that is within 0.05 of the actual population proportion with 95% confidence.

A second limitation is related to the sampling method, where there was a self-selection bias. (That is, the only responses came from those who decided to participate in the study, and therefore they cannot be relied on to be truly representative of the entire group of professionals.) This is an extremely difficult problem to minimize. Our recommendations are that any follow-up studies should attempt to try to ensure a high response rate from the population by carefully selecting a target group, and, if possible, to determine the reasons why individuals decided not to participate in the study. This will not eliminate the problem, but may reduce (or at least characterize) the self-selection bias effects to some degree.

4. DISCUSSION

It is perhaps not surprising to note that security professionals differ markedly from the general population, with a significant difference noted on each dichotomous preference. Security professionals are especially highly represented amongst INTJs, with 34% of the population. In comparison, the general population of the United States is only 3.5% INTJ [13].

What is perhaps more surprising are the differences between software engineers and security professionals. It would have been expected that individuals in these two professions would be more similar, given the similar nature of the profession and of the background training. However, Capretz noted that the majority of software engineers (24%) were ISTJ [5]. In addition, he noted that a large number of software engineers (67%) preferred sensing to intuiting. His findings were supported by previous studies, such as Bush and Schkade [4], Buie [3], Lyons [18], and Smith [27], all of whom noted that ISTJs were the most prevalent type among high-tech aerospace, scientific programmers in a private company, large organizations and a large insurance company respectively. Similarly, Canadian engineering students have been found to have ISTJ as the predominant type [25]. When comparing against computer science students, Werth found that they were much more likely to be intuitive than the general population (51% versus 32%) [30], however they are still much more sensing than security professionals (49% versus 14.5%).

Similarly, security professionals differ markedly from police officers, who are also vested with security and investigative responsibilities. While a similar distribution occurs in the thinking-feeling dichotomy (both groups are similarly under-represented in the feeling dichotomy), the two groups diverge on the other three dichotomies, and again security professionals demonstrate a marked difference on the sensing-intuiting dichotomy. In addition, Hanewicz noted that police officers were largely ESTJs (20.7%) and ISTJs (14.0%) [14], whereas security professionals had no representation among the ESTJs and only 5.3% ISTJs. In contrast, while security professionals were largely INTJ (34.2%), only 2.3% of police officers had this MBTI type. Indeed, Hanewicz even commented in his article on the lack of intuitive types, stating "The disproportionately low number of intuitive (N) types is conspicuous...."

In comparison to software engineers and police officers, a large majority of security professionals (85.5%) preferred intuiting to sensing. Lyons [18] noted that state-of-the-art development organizations tended to attract more Ns than Ss, versus large organizations that were involved in large amounts of maintenance and system enhancement. It is also interesting to note that people in supervisory positions (e.g. first level managers) at the National Security Agency (NSA) in the United States are predominantly ISTJ (27%) [12]. NSA executives are also predominantly ISTJ (24%), but there are significantly more INTJs at this level (14% versus 7%). This was explained as being related to job function, where supervisors need to be concerned "with reality and practical issues", while executives need to "focus on possibilities, options, and alternatives."

This implies that the majority of security professionals prefer to concentrate on the larger picture and think of future possibilities. While these are certainly valuable traits, we are at the same time lacking in those individuals who prefer to concentrate on solving the current issues with the tools that are currently available. This arguably puts the defenders at a disadvantage, if all the defenders are concentrating on how security can be made better, rather than on defending the attackers right now.

In addition, it is possible that diversity within the security community is required for anticipating problems and attacks. If those with similar personality types also have similar modes of problem solving, then a homogeneous group may have trouble predicting what an "outsider" might do; in this case, an attacker with a different approach could exploit vulnerabilities in an unexpected way. Having a diversity of approaches, through diverse personality types, could minimize this weakness. (This particular point is mere speculation; we are not psychologists, and have not explored this aspect of personality research.)

It is also interesting to note that the women security professionals differ on more scales from the female general population than do the men, and that women do not differ markedly from men (except that there are significantly more sensing women, which may be a reflection on the fact that women in general are more likely to be sensing then men).

An unanswered question is why the sampled population tested as INTJ. This may be due to inaccuracies introduced via the test or testing methodology. However, if this is not the case, then we must consider what factors led to such high representation among one personality type. Possible reasons for this may be that certain types of people are not be attracted to the security profession, or that some types of people dropped out of the profession when they found it to be unfulfilling. Longitudinal studies would be required to answer these questions, incorporating an examination of societal factors in career selection and personnel retention.

5. CONCLUDING REMARKS

One of Sun Tzu's basic tenants for any army was to know thyself [29]. Yet little work has been performed on the study of security defenders. This paper is a first attempt to rectify this situation.

Using the Myers-Briggs Type Indicator as a tool to determine if there were personality similarities amongst security professionals, we found a predominance of INTJ types. This type is relative rare in the general population, comprising only 3.5% [13], and yet comprised 34% of security professionals in our sample. From the "popular psychology" standpoint [28], INTJs are perfectionists who value personal competence and their own original ideas; they also tend to not invite others to assist with their projects, and may not see practical weaknesses in their plans. Our study cannot validate this generalization; however, it does appear that a large proportion of our sample group exhibits similarity, judging by their questionnaire responses.

Security professionals were also found to have a very strong preference for intuition (85.5%) on the intuiting-sensing dichotomy, which is in marked contrast to the general population, which is only 32% intuiting. This is also in marked contrast to the preferences found in software engineers [5], computer science students [30], engineering students [25], and other related fields, all of whom preferred sensing to intuiting. This is also in marked contrast to the preferences of police officers, who are also involved on a daily basis with security and investigation. This result implies that security professionals are more focused on "the big picture", and that we have few practitioners who are focused on "the here and now." This aspect would benefit from further investigation, using other tools and methods than the coarse-grained MBTI instrument. One alternative would be to use the Five-Factor model for further personality analysis [8]. As well, it may be beneficial to conduct interviews with security professionals about their problem-solving methods.

In order to develop an effective defensive strategy, it is important to not only know the attackers, but also to understand the defenders. Additionally, it is arguable that our defences can be bettered by employing different personalities with different approaches to problem-solving. Yet our pilot study shows that security professionals represent a narrow range of personality types. Thus this study indicates the need for further research to determine the extent to which security professionals are similar. Additionally, studies should be performed that employ a mixture of personality types, to determine if the different approaches can result in better defences.

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