



Defender Personality Traits

Tara Whalen
Carrie Gates

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Faculty of Computer Science
6050 University Ave., Halifax, Nova Scotia, B3H 1W5, Canada

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Tara Whalen and Carrie Gates

Faculty of Computer Science,
Dalhousie University,
Halifax, NS, B3H 1W5, CANADA,
{whalen, gates}@cs.dal.ca

Abstract. The security community has used psychological research on attacker personalities, but little work has been done to investigate the personalities of the defenders. One instrument currently dominating personality research is the Five Factor Model, a taxonomy that identifies five major domains of personal traits, composed of sets of facets. This model can be used within an organizational or vocational capacity to reveal dominant tendencies, such as openness to new experiences. Within a security context, this tool could show what patterns professionals exhibit, which may reveal the areas in which we are insufficiently diverse and where our blind spots are.

We surveyed 43 security professionals using a Five Factor Model-based test (the IPIP-NEO) to reveal common dominant traits. We found that our sampled security population demonstrated that they were highly dutiful, achievement-striving, and cautious; in addition, they were high in morality and cooperation, but low in imagination. We conclude that many of these characteristics are appropriate for security professionals, although the low scores in the “openness to experience” domain may indicate difficulties in devising new security defense methods and in anticipating new forms of attack. This potentially leaves large organizations and nation-states vulnerable to attacks that might have otherwise been prevented.

1 Introduction

Within the security community, psychological research has traditionally been directed towards attackers: for example, the psychology underlying insider threats[21] or criminal hacker behavior[19]. However, another piece of the overall picture is the psychology of the defender who must guard against these threats. It is useful to understand how personality traits influence the effectiveness of security defenders. This in turn might indicate where there may be weaknesses in our defence strategies.

There have been some recent steps in this direction. Greenwald *et al.*, in a panel on psychology in security, noted that profiling defenders might be “the most promising solution to the non-acceptance factor: a sensation-seeker is a risk taker, so he/she will not buy an InfoSec software package; if bought by

somebody else, they will not install it; if forced to install, they will use the first customer complaint about a performance deficit as an excuse to uninstall it.” [8].

We build upon an initial study using the Myers-Briggs Type Indicator [6], using another current personality test: the Five Factor Model. This model has enjoyed recent favor within the psychology community, and has been widely adopted as a comprehensive testing instrument. This paper presents the results from having a group of security professionals complete the test. Section 2 describes the Five Factor Model used as the basis of our investigation. Section 3 presents our experimental methodology and statistical results. Section 4 discusses how the personality profiles may affect security practice. Section 5 presents some related work in this area, and we conclude with some summary remarks in Section 6.

2 The Five Factor Model

2.1 Overview of Five Factor Model

A dominant taxonomy within current personality research is the Five Factor Model (FFM), closely related to the “Big 5” model. Both of these models use five basic domains, containing subfactors (or “facets”) that make up each category. The five domains have slightly different names under the two models, but are essentially quite similar. FFM uses the “OCEAN” domains: Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism [7]. A person will have different levels of each trait, which are compared to the rest of the population; for example, a person’s test results may show that he is less extraverted than the average test subject, but more open to experience. The five FFM domains are described in detail below; the facets are from the International Personality Item Pool Representation of the NEO-PI-R (IPIP-NEO), which was the FFM test used in this study [7].

Openness to Experience: this domain demonstrates a person’s comfort with new ideas, abstractions, and imagination. The IPIP-NEO test characterizes Openness to Experience in the following way, “Open people are intellectually curious, appreciative of art, and sensitive to beauty. They tend to be, compared to closed people, more aware of their feelings. They tend to think and act in individualistic and nonconforming ways...Another characteristic of the open cognitive style is a facility for thinking in symbols and abstractions far removed from concrete experience” [12]. The facets of Openness are emotionality, artistic interests, imagination, adventurousness, liberalism, and intellect. (Note that intellect does not mean intelligence; rather, it refers to enjoyment of playing with ideas rather than with concrete people or things.)

Conscientiousness: this domain deals with impulse control and spontaneity. The IPIP-NEO states that “Impulses are not inherently bad; occasionally time constraints require a snap decision, and acting on our first impulse can be an effective response. Also, in times of play rather than work, acting spontaneously and impulsively can be fun...Nonetheless...Acting impulsively disallows contemplating alternative courses of action, some of which would have been wiser than

the impulsive choice. Impulsivity also sidetracks people during projects that require organized sequences of steps or stages” [12]. The facets of Conscientiousness are self-efficacy, orderliness, dutifulness, achievement-striving, self-discipline, and cautiousness.

Extraversion: this domain describes the degree of engagement with the external world. According to the IPIP-NEO “Extraverts enjoy being with people, are full of energy, and often experience positive emotions...In groups they like to talk, assert themselves, and draw attention to themselves. Introverts lack the exuberance, energy, and activity levels of extraverts. They tend to be quiet, low-key, deliberate, and disengaged from the social world” [12]. Introversion can sometimes be misinterpreted as depression or unfriendliness; however, introverts merely require less interaction with the social world, and may be quite agreeable and content. The facets of Extraversion are friendliness, gregariousness, assertiveness, activity level, excitement-seeking, and cheerfulness.

Agreeableness: this domain is focused on how much people value getting along with others. The IPIP-NEO states that “Agreeable individuals value getting along with others. They are therefore considerate, friendly, generous, helpful, and willing to compromise their interests with others’. Agreeable people also have an optimistic view of human nature. Disagreeable individuals place self-interest above getting along with others. They are generally unconcerned with others’ well-being, and therefore are unlikely to extend themselves for other people” [12]. Agreeable people may be more popular, but disagreeableness can be an asset when making hard objective decisions. The facets of Agreeableness are trust, morality, altruism, cooperation modesty, and sympathy. (Note that morality in this context does not refer to one’s stance on issues of social significance, such as euthanasia, but rather indicate characteristics such as sincerity and lack of guardedness about telling the trust.)

Neuroticism: this domain has a somewhat misleading title, as it suggests the individual is suffering from Freudian neurosis. In current psychology parlance, neuroticism refers to a person’s inclination to experience negative emotions (such as anxiety). According to the IPIP-NEO “People high in neuroticism are emotionally reactive. They respond emotionally to events that would not affect most people...These problems in emotional regulation can diminish a neurotic’s ability to think clearly, make decisions, and cope effectively with stress...individuals who score low in neuroticism are less easily upset and are less emotionally reactive. They tend to be calm, emotionally stable, and free from persistent negative feelings” [12]. Note that those who are low on the neuroticism scale may not necessarily have positive emotions most of the time, merely a lack of frequent negative feelings. The facets of neuroticism are anxiety, anger, depression, self-consciousness, immoderation, and vulnerability.

2.2 Development of the Five Factor Model

The International Personality Item Pool (IPIP-NEO) online test, used in this study, was created by Goldberg in 1999[7]. It was designed to measure the same aspects as the NEO PI-R test (which is proprietary), as well as to be short enough

to encourage subject completion. The IPIP researchers claim a high degree of correlation between the IPIP-NEO and the NEO PI-R test[7].

2.3 Scoring

A test subject who takes a Five Factor Model test (such as the IPIP-NEO) is presented with a series of questions to determine the level of a particular facet within each of the five domains. The score is based on a continuum, with subject scores falling along a normal distribution. Approximately half of the questions are keyed positively (towards the high end of the scale) and the other half, negatively; this provides some balance so that the responses are not biased toward one type of response.

Let us consider the example of one facet-sympathy-within the domain of Agreeableness. Some questions within the entire test would be designed to measure sympathy. Approximately half would be phrased positively (“Feel sympathy for those worse off than myself”) and half negatively (“Am not interested in people’s problems”)[7]. Responses, in the IPIP 120-item test, are based on a 5-point Likert scale; the person can agree or disagree as to whether the statement describes them accurately or not. The responses provide a level of sympathy, which can be compared to other test subjects, based on a normal distribution. We then see where the person falls in comparison to others, in terms of sympathy: less sympathetic, more sympathetic, or average. Sympathy can then be combined with other traits within the Agreeableness domain (such as morality and trust) to give an overall domain score, which again is located within a normal distribution. In summary, a person is evaluated in terms of an overall population, giving a comparative score expressed as a percentile.

3 Method

3.1 Sampling Procedure

We conducted a survey of security professionals in order to determine their personality characteristics using the NEO PI-R instrument [14]. This instrument is based on the Five Factor Model, which is widely accepted in mainstream personality psychology [16]. The other popular personality assessment device is the Myers-Briggs Type Indicator®(MBTI)¹, which assigns respondents to one of 16 personality “types”. However, this tool is generally not as popular amongst psychologists [16]. We therefore chose the FFM, and concentrate on measuring personality traits as opposed to types.

The original NEO PI-R is copyrighted by Psychological Assessments Resources Inc. and is available for purchase by professionals [18], however we did not have the financial resources to use this particular test. In addition, this test

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

has 240 questions and takes 35 to 45 minutes to complete. Given that our participants were all volunteers, we felt that they would be unwilling to invest that much time in completing the survey.

We therefore chose a related test, the IPIP (International Personality Item Pool) NEO [7][11], which is similar to the NEO PI-R [14]. The full IPIP test is in the public domain, however it consists of 1,699 questions. We therefore use a modified version of this test, developed by Dr. Johnson and available at <http://www.personal.psu.edu/faculty/j/5/j5j/IPIP/ipipneo120.htm>. This version consists of 120 questions about personality traits (e.g. love large parties, prefer variety to routine), which subjects are asked to rate on a 5-point Likert scale from very inaccurate to very accurate. The answers are used to determine scores on 30 facets of personality, which are aggregated into five broad domains: neuroticism, extraversion, openness to experience, agreeableness and conscientiousness. This particular form of the IPIP NEO personality test has been tested against more than 20,000 respondents to ensure that it has an acceptable measurement reliability.

The on-line questionnaire was converted to a paper format where subjects were asked to fill in the bubble for the response that most closely described them. The questionnaires were disseminated with the registration packets at the Annual Computer Security Applications Conference (ACSAC), held in December 2004. There were 177 attendees at this conference, 43 of whom returned completed survey questionnaires, providing a response rate of 24.3%. The attendees at this conference cover a broad spectrum of security professionals, including both researchers and practitioners.

3.2 Analysis

There were 43 responses to the survey: 31 men (72%), ten women (23%) and two people who did not provide their sex. (This is representative of the field in general, where the percentage of women employed in a computer/information science position in the United States is 26% [17].)

Of the 43 responses, we discarded the two who did not provide their sex, as well as an additional questionnaire where the true responses were difficult to determine. Of the remaining 40, only 23 responses were complete (no missing or ambiguous answers). The remaining 17 questionnaires were either missing results for one or more questions, or had some ambiguous answers (e.g., two responses checked for a single question). In order to include these responses, we determined the personality domain for the missing or ambiguous questions and then removed the results for this user for those domains from further consideration. This left us with $N = 34$ for extraversion, $N = 35$ for neuroticism and openness, $N = 37$ for conscientiousness and $N = 39$ for agreeableness.

The results were analysed using the data collected and scripts written by Dr. Johnson (see <http://www.personal.psu.edu/faculty/j/5/j5j/IPIP/ipipneo120.htm>). His programs calculate scores for each of the 30 facets and five personality domains. It then compares these scores against scores that have been collected over time from a large number of people to determine the percentile into

which the respondent falls. The only number reported to the respondent is their percentile score. This would indicate, for example, that a respondent is more extraverted than some percentage of the general population.

We obtained the scripts used on this web site, along with a spread sheet of the percentile scores on which the calculations are based. The original scripts calculate percentiles where a respondent is compared against others of the same sex and age range. However, we did not collect any demographic information on age, and so modified the scripts to not use this particular data. We therefore calculated percentiles using sex as the only discriminator, where these values were based on responses from 7743 men and 13,524 women, representing the results collected by the web site over some period of time. We assume that this population is reasonably close to the general population, although it still suffers from the self-selection bias.

We manually entered the data for each respondent via a web page, and recorded the percentile results that were obtained. We grouped the resulting scores into low, medium and high categories, where low indicates that the respondent was below the 30th percentile, high indicates the respondent was above the 70th percentile, with the remainder being the medium. The results from dividing the scores in this manner for both the overall domains and each of their facets are presented in Table 1. We also present the results across the five domains for men and women in Tables 2 and 3 respectively. We note, however, that the number of women participants in the study is too small to draw any gender-based conclusions.²

We performed a χ^2 test for significance with two degrees of freedom, comparing our actual results for each domain with the expected results given a uniform random distribution. We assume that the expected result fits a uniform random distribution because we are using percentiles, which is a strict ranking. Therefore we would expect 30% of respondents to have a percentile score on any particular domain of less than or equal to 30 and 30% of respondents to have a percentile score of greater than 70, with the remaining 40% falling between 31 and 70 inclusive.

We examined each domain independently to determine if our respondents differ from the expected values. We found significant differences across two of the five domains. Respondents to our study had unusually high values for conscientiousness ($p = 0.001588$) and unusually low values for openness ($p = 0.01771$). Respondents also generally had high values for agreeableness, with $p = 0.06232$, which suggests that we should examine a larger sample to determine if this might actually be significant or if it is an artifact of our sample size.

Regardless of the significance (or not) of each domain, four of the five domains had at least one facet that showed a significant deviance from a uniform distribution. We start with the two domains that demonstrated significance: conscientiousness and openness. In the domain of conscientiousness, respondents demon-

² Even when the binning strategy for the percentiles for each domain was changed to only two — low ($< 50\%$) and high ($\geq 50\%$) — the number of female participants is still too low to provide reliable statistical results.

Domain and Facets	Low	Medium	High	Total
Extraversion	13	14	7	34
Friendliness	12	11	11	
Gregariousness	12	15	7	
Assertiveness	4	21	9	
Activity Level	4	13	17	
Excitement-Seeking	22	10	2	
Cheerfulness	11	13	10	
Agreeableness	5	21	13	39
Trust	6	20	13	
Morality	4	13	22	
Altruism	6	22	11	
Cooperation	3	15	21	
Modesty	6	20	13	
Sympathy	12	15	12	
Conscientiousness	1	20	16	37
Self-Efficacy	8	20	9	
Orderliness	11	12	14	
Dutifulness	3	19	15	
Achievement-Striving	3	17	17	
Self-Discipline	7	17	13	
Cautiousness	2	17	18	
Neuroticism	14	13	8	35
Anxiety	11	12	12	
Anger	16	11	8	
Depression	14	13	8	
Self-Consciousness	10	16	9	
Immoderation	8	18	9	
Vulnerability	11	17	7	
Openness to Experience	18	11	6	35
Imagination	23	10	2	
Artistic Interests	12	17	6	
Emotionality	14	14	7	
Adventurousness	15	11	9	
Intellect	8	19	8	
Liberalism	8	10	17	

Table 1. The distribution of results among low, medium and high scores for the five domains and each of their facets.

strated significance across three different facets. Unusually high percentiles were found for dutifulness ($p = 0.01618$), achievement-striving ($p = 0.009718$) and cautiousness ($p = 0.002516$). Thus, as a group, our respondents demonstrate that they have a strong sense of duty and obligation, that they work hard and strive towards excellence, and that they take time before making decisions.

3. METHOD

Personality Domain	Low	Medium	High	Total
Extraversion	8	11	6	25
Agreeableness	3	16	11	30
Conscientiousness	1	14	12	27
Neuroticism	12	8	7	27
Openness to Experience	13	9	4	26

Table 2. The distribution of results among low, medium and high scores for men.

Personality Domain	Low	Medium	High	Total
Extraversion	5	3	1	9
Agreeableness	2	5	2	9
Conscientiousness	0	6	4	10
Neuroticism	2	5	1	8
Openness to Experience	5	2	2	9

Table 3. The distribution of results among low, medium and high scores for women.

In terms of openness, our respondents demonstrate significance on the facet of imagination. Our results show that the survey respondents have a *very* low score for imagination, with $p = 0.00000973$. This implies that our respondents are very much more oriented towards facts rather than fantasy. Additionally, our responses show a strong tendency towards liberalism, although it is not significant ($p = 0.05136$), where this implies that our respondents tend to challenge authority and traditional values. The low p -value here suggests that a larger sample size might indicate if this is truly a significant trait.

Respondents also exhibited significance on two facets in the agreeableness domain. The percentile scores for morality were unusually high ($p = 0.0006445$), indicating that the respondents tended to be very sincere and straight-forward, demonstrating little need for pretense. Respondents also scored highly for cooperation ($p = 0.0009478$), indicating a high willingness to compromise and a desire to avoid confrontations.

Interestingly, while the percentile distribution for extraversion exhibited no significance ($p = 0.4121$), there were three facets within extraversion where there was significance. These facets were assertiveness ($p = 0.02369$), activity level ($p = 0.01526$) and excitement seeking ($p = 0.00002304$). Respondents showed an unusually high activity level, indicating a busy, fast-paced lifestyle and involvement in a large number of activities. On the opposite extreme, respondents also demonstrated unusually low scores for excitement-seeking, indicating that they do not like commotion and do not tend to be thrill-seeking. The third facet, assertiveness, indicates a person's comfort with speaking out and taking charge. What is interesting about this facet is that respondents scored consistently in the middle range, whereas all other facets that were significant exhibited ex-

tremes (e.g. unusually high or unusually low scores). Assertiveness is the only facet where respondents were unusually average!

3.3 Limitations of the Study

There are a number of limitations of this experiment which must be considered when interpreting our results. First, there is self-selection bias to consider: the questionnaire was handed out to conference attendees, who could choose whether or not to complete and return it. We gathered no data on participants who did not complete the test, which means that we may, for example, have gathered no data on people who had no time to participate, or who dislike completing tests. We are unable to characterize this bias, as we have no data on why individuals did not complete the questionnaire. Second, our sample consists only of attendees at the ACSAC conference. Although this group represents a cross-section of the security community, it cannot represent the entire population. Therefore, we cannot generalize to the entire set of security professionals. Third, our sample population is not large: we gathered only 43 responses, some of which had to be discarded. We were able to find statistically significant results, but with such a low sample, some caution is appropriate. Finally, despite its popularity, the Five Factor Model is not without controversy. One of the most prominent critics is Block, who outlined his views in a set of 1995 papers[2],[3]. In summary, Block faults the model for its lack of grounding in a theoretical model, for its misapplication of factor analysis, and its reliance on self-reporting and restricted laymen's terms in the questionnaires. This debate remains far from settled within the psychological community.

4 Discussion

Survey participants scored high for the conscientiousness domain, and low for the openness domain. The conscientiousness domain relates to spontaneity and acting impulsively, and a high score indicates that respondents are not prone to being impulsive, but are prudent instead. Conscientious individuals are considered to be careful planners, reliable and persistent. However, they can also be perfectionists and workaholics. In particular, survey respondents indicated a strong desire to be recognized as successful, which can also be an indication of being obsessed with work. Additionally, respondents had a strong sense of duty and moral obligation, and tend to think carefully before committing to a decision. It can be argued that these are all good characteristics to have in a security professional, and that not having a balance in this particular category is not necessarily detrimental to the field. However, this cautiousness may be an issue given events that require a rapid response, such as when an intrusion has been detected. This is especially true given the finding by Cohen [4] that a rapid response time is often a better strategy than having a large number of defences.

On the opposite extreme, survey participants had particularly low scores on the domain openness to experience. This implies that respondents are very practical and down-to-earth, rather than imaginative and creative. At first glance,

this domain deals more with the appreciation of art and beauty, and so it may not be surprising that computer security professionals score low on this domain. However, citing from Dr. Johnson’s descriptions of the domain [13], a high score on this domain indicates a “facility for thinking in symbols and abstractions” which can take the form of “mathematical, logical, or geometric thinking” in addition to more artistic cognitive styles. Further, it is stated that people with low scores here “may regard the arts and sciences with suspicion, regarding these endeavors as abstruse or of no practical use.” Given that the “intellectual style of the open person may serve a professor well” it is surprising that the survey respondents scored so low on this particular domain. This particular style of thought might indicate a weakness in security professionals as a whole, and the field might benefit from including more individuals with an open cognitive style as they might be more likely to discover truly new methods to counter cyber-adversaries. However, it is interesting to note that “research has shown that closed thinking is related to superior job performance in police work.” Given that computer security and police work could be considered to be related, this may provide some explanation of the low scores on this particular domain.

Other facets on which respondents scored highly included morality and cooperation (both part of the agreeableness domain). It could be argued that high morality is a desired trait in a security professional, as it could be expected that they should not exhibit any deception, nor should they be guarded about providing the whole truth. However, respondents also scored high for cooperation, indicating a dislike of confrontations and a desire to get along well with others. This trait might be desirable in the work-place, but is interesting to find in security professionals given that the profession is founded on confrontation between security professionals and adversaries. However, this can also be viewed that security professionals provide safe-guards to *prevent* confrontations with adversaries!

5 Comparison to Related Work

While a number of articles have been published that relate the five factor model to work performance (e.g., see [1] and [20]), very little seems to have been published relating the five factor model to particular career choices. The literature that does deal with this area has been described as “less well articulated”, stating that it is “difficult to formulate hypotheses regarding FFM traits and the nature of employment.” [5]

One article that does address this area, however, is by De Fruyt and Mervielde [5]. This article uses the five factor model as a predictor of both employment status and the nature of employment, in combination with the RIASEC model. The RIASEC model is a theory of vocational personalities that has been developed by John Holland [10]. This model contains six personality types — Realistic, Investigative, Artistic, Social, Enterprising and Conventional — and it is argued that these six types also represent vocational environments. Realistic personalities are considered to be doers, and prefer to work with things rather than

people. Investigative personalities are thinkers, who enjoy abstract problems, while artistic personalities are creators who prefer environments where they can exhibit self-expression. Enterprising personalities are persuaders who enjoy leading, speaking and selling, while conventional personalities are organizers who are conservative and orderly. (These descriptions have been adapted from <http://edtech.jmu.edu/bis/RIASEC.htm>.) De Fruyt and Mervielde [5] found that a low score on openness predicts employment in a realistic vocation. Sample vocations in this domain include electrical engineers, software technicians and police officers. They also found that a high score on conscientiousness also predicted work in realistic vocations. Interestingly, computer analyst, which should require similar traits to a security professional, is an investigative vocation and not a realistic one.

While little has been published comparing the five factor model to career choices, there are numerous articles comparing the Myers-Briggs Type Indicator (MBTI) to career choices. In a previous paper, we analysed the MBTI types of 79 security professionals [6]. The MBTI consists of four dichotomous domains: extraversion/introversion (EI), thinking/feeling (TF), sensing/intuiting (SN) and judging/ perceiving (JP). We found that security professionals are different from the general population of the United States across all four dichotomies, tending to be more introverted, intuiting, thinking and judging. In particular, we found a predominance of INTJ types, who tend to be “perfectionists who value personal competence and their own original ideas.” We also noted a very strong preference in our sample for intuition (85.5%), which is markedly different from the general population (32%). This indicates a strong preference for focusing on meanings and possibilities, and a low preference for dealing with details or observable phenomenon.

Several comparisons have been made between the five factor model (FFM) and the Myers-Briggs Type Indicator (MBTI) [9]. Gruber summarizes research in this area in [9], noting that FFM extraversion is related to the MBTI extraversion/ introversion dichotomy, Openness is related to the sensing/ intuiting dichotomy, with a high score here indicating intuition. The thinking/feeling dichotomy is related to agreeableness, with a high score in agreeableness being related to feeling and a low score to thinking. Finally, the judging/perceiving dichotomy is similar to conscientiousness, with a high score being similar to judging and a low score to perceiving.

Using the mappings outlined in [9], a low score on openness indicates MBTI sensing types, a high score on conscientiousness indicates MBTI judging types, and a high score on agreeableness indicates MBTI feeling types. This results in type xSFJ. Examining the relationships identified by McCrae and Costa [16], the thinking/feeling dichotomy is less clear. This is because, while a high score on agreeableness is positively correlated with feeling types, a high score on conscientiousness is *negatively* correlated with feeling types. However, MacDonald *et al.* [15] find the correlation between agreeableness and feeling (0.52) to be significant, while the negative correlation between conscientiousness and feeling is not (-0.02). MacDonald *et al.* [15] also found that intuiting was positively cor-

related with agreeableness, however we do not use this to strongly influence our hypothesized corresponding MBTI type as this result was not found by McCrae and Costa [16].

We find that our result (MBTI type xSFJ) is different across two dichotomies from the result found in our earlier work on a similar sample population [6]. Our respondents demonstrated a very low score for openness indicating a very sensing-based population, which is markedly different from the previous study, which found that the security population was extremely high in intuiting. Similarly, we found that our population is more predisposed to be the feeling type, while the previous population was high on the thinking scale.

These differences are unusual, and require some explanation. One possible explanation is that the mappings between the MBTI and FFM models are not particularly accurate. For example, the MBTI indicates that someone who is feeling tends to make decisions based on social considerations while someone who is thinking focuses on facts. This does not map well to agreeableness, which deals more with how people relate to others and not with what factors they consider when making decisions. For example, someone who tends towards facts and figures is not necessarily uncooperative or immodest.

Another possible explanation could be related to size of the sample population and the limited number of questions used in the FFM survey. For example, many of the questions regarding openness to experience could be interpreted more harshly given the audience. One example here is the trait “enjoy theoretical conversations.” This might have been interpreted with the more narrow view of computer science theory, and less with the more broad view of “what if” types of conversations. Similarly, one of the questions was “enjoy going to art museums”, which is again very specific. It might be the case that, while respondents do not enjoy going to art museums, they might enjoy going to the symphony, and so answering no to this question does not necessarily reflect an overall lack of artistic interest. Thus it might be the case that the 240-question version of the survey would provide different results than the 120-question version.

Another possibility is that, while the sample population for both this study and our previous study [6] consisted of security professionals, that the sampling strategy resulted in very different people responding. For example, we sampled here from the Annual Computer Security Applications Conference, which could imply that we are more likely to encounter individuals concerned with the applied aspects of security and so have lower scores on openness and are therefore more sensing in MBTI parlance. In contrast, the previous study sampled from among primarily academic contacts, and so the respondents might be more likely to be intuiting.

6 Concluding Remarks

Our Five Factor Method analysis of security professionals revealed some interesting dominant personality traits. In particular, participants scored high in the conscientiousness domain, and low in the openness domain. Having highly-

conscientious defenders appears to be beneficial, as it indicates caution, a tendency to plan, and thoroughness. However, it may also be the case the security professionals may not respond quickly in time critical situations such as when an intrusion has occurred. The low score in the openness to experience domain could indicate rigidity of thought, although the questionnaire focuses mainly on artistic sensibilities rather than general acceptance of unusual ideas. However, this aspect is generally high in professors and researchers, which may indicate that security professionals may not be inventive in creating new security mechanisms.

Security professionals also demonstrated significant deviances in Some of the individual facets within each of the five domains. For examples, respondents had a *very* low score for imagination, which is related to the low score on openness to new ideas. Respondents scored very highly on co-operation, which is unusual given that the field is inherently one of conflict, of defenders versus adversaries. The high level of co-operation might be a good trait, indicating the security professionals tend to work well together. Alternatively, it might reflect a weakness given the aversion to conflict. Security professionals also scored unusually high on the facet for activity level, indicating the preference for a busy life-style with the need to balance many activities. If security professionals have positions that mimic their personality preferences, then this could possibly result in the professional being subject to missing important security information due simply to not having the time or inclination to focus on any one particular area.

One additional finding is that the majority of our respondents were not excitement seeking ($p = 0.00002304$); this indicates a risk-averse population. Again, this may be desirable in a security group: one is attempting to reduce the risk and consequences of a security breach. However, it may also signify that defenders take conservative approaches when they tackle a problem, fearing a negative outcome. It may be necessary to create organizational structures where “contained failure” is supported, so that experimental approaches can be developed without the possibility of actual system damage.

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