

## Personal Values and Cyber Risk-Taking

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### ABSTRACT

This research explores the relationship between personal values and the tendency to take cyber-risks. We first develop and add six cyber-risk items to the well-known Domain-Specific Risk-Taking (DOSPERT) scale. Importantly, we show that like the other five domains examined by the scale (Health, Ethical, Financial, Recreational, and Social), these cyber items form a separate cluster.

We then examine the association between values and cyber risk-taking behavior. We find that “conservation (conservatism)” values are negatively correlated with the tendency to take cyber risks. Thus, individuals prioritize conservation are less likely to take cyber risks. We also find that “openness to change” values are positively associated with the tendency to take cyber-risks. Individuals who value openness to changes are prone to take cyber risk. The findings suggest possible “values based” interventions in order to increase cyber-security.

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### Introduction

In 1985, intangible assets accounted for one-third of the value of S&P 500 firms, while tangible or physical assets accounted for two-thirds of the value of these firms. Over time, the percent of intangible assets of S&P 500 firms, many of which are digital, has increased dramatically, reaching 84 percent in 2018.<sup>2</sup> Digital assets face cyber risks, yet there seems to be a dissonance between (i) the acknowledgment that such cyber risks have increased dramatically over time and (ii) action to address the problem.<sup>3</sup>

While technological solutions may help to improve information security, humans are typically the weakest link in internet security

[1, 2]. The idea that technology will provide complete protection against phishing, malware, or ransomware attacks is a fallacy. Hence, an important question is what type of individuals are more likely to take cyber risks.

Research in cybersecurity has examined the relationship between individual characteristics/traits (gender, age, impulsive, opportunistic, etc.) and the tendency to take cyber risks. However, to the best of our knowledge, no research has addressed the relationship between personal values and cyber risks, which is the focus of this study. In this paper, we apply the vast knowledge accrued on personal values in order to determine what values are associated with the taking of cyber risks. Before we begin, we provide a brief introduction to empirical research on values.

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<sup>2</sup>See <https://www.bloomberg.com/news/articles/2020-10-21/epic-s-p-500-rally-is-powered-by-assets-you-can-t-see-or-touch>.

<sup>3</sup>The New York Times reported (on August 23, 2019) that more than forty local governments in the United States suffered cyber-attacks in 2019. See Ransomware Attacks Are Testing Resolve of Cities Across America, by New York Times, By Manny Fernandez, David E. Sanger and Marina Trahan Martinez, available at <https://www.nytimes.com/2019/08/22/us/ransomware-attacks-hacking.html>.

## Empirical Research on Values

Personal values are cognitive representations of abstract, desirable motivational goals that guide the way individuals select actions, evaluate people and events, and explain their actions and evaluations [3-7]. They are a core aspect of people's identity, and serve as standards or criteria that provide social justification for choices and behaviors across situations. Values are recognized as important psychological constructs, because, as guiding principles in people's lives, they are hypothesized to have wide-ranging effects [8-10]. All values may serve to motivate actions, depending on their accessibility and relevance to the situation. The higher a value is in the hierarchy, the more likely it is to motivate action and affect behavior [11]. Values affect the attractiveness of alternative courses of action by influencing the valence of behaviors that help attain them, which in turn makes it more likely that individuals will engage in those behaviors [12, 13]. That is, values lead people to act in ways that promote their attainment, and refrain from acting in ways that block it [14]. Values are especially good predictors of behaviors over which individuals have some cognitive control or choice and when behavior is not regulated by social norms [15, 16].

## Values and Risk

The effect of values on risk has been documented in Griffin et al. who found a positive relation between culture level values on risky corporate investment decisions, in which individualism values are positively related to risky decisions and uncertainty avoidance is negatively related to risky decisions [17]. Evidence for the effect of personal values and risk is reported in Berson et al. who tested the relationship between CEO values and organizational culture found that CEOs who are high on conservation values (security in particular) would be expected to inhibit the formation of innovation cultures, which highlight work flexibility and the tendency to take risks [18]. In contrast, CEOs who emphasize innovation and risk-taking place lower priority on conservation values. "Openness to change" values were also associated with the tendency to risky forms of political activism (like protests) and risky sexual behaviors [19, 20]. However, none of these studies examined the effect of values on cybersecurity risks.

## Theoretical Foundation and Our Hypotheses

The Schwartz value theory is particularly useful for studying behavior related to cyber security because it seeks to provide a comprehensive mapping of values according to the motivations that underlie them [7].<sup>4</sup> Schwartz identified ten value types forming a circular structure.<sup>5</sup> According to Schwartz, values differ in the motivational goals to which they are directed [7]. Schwartz developed a higher-order classification and grouped the ten values into four broader categories:

(i) Openness-to-Change (ii) Conservation (iii) Self-Enhancement and (iv) Self-Transcendence.<sup>6</sup> These four broad categories illustrate two basic conflicts:

1. "Openness to change" values express the motivation for autonomy of thought and action (self-direction), and for novelty and excitement (stimulation). These values typically conflict with conservation values that express the motivation of preserving the status quo: commitment to past beliefs and customs (tradition), adhering to social norms and expectations (conformity) and

preference for stability and safety (security).

2. Self-enhancement values express pursuit of self-interest by focusing on gaining control over people and resources (power) or by demonstrating ambition, competence and success (achievement). These values conflict with self-transcendence values that express concern and care for close others (benevolence) or acceptance and tolerance of all people (universalism).

## Hypotheses

The relation of openness to change values with risk taking and conservation values with safety and caution is driven by the motivations these values express, openness to change values express the goal to seek novelty and exciting experiences, that ultimately involve risk. In contrast, conservation values express the goal of order, secureness and preservation of the past that ultimately promote more safe and familiar experiences [24].

As with risks from other life domains, we hypothesize that the tendency to take cyber risks will be positively correlated with openness to change values and negatively correlated with conservation values. Intuitively, individuals who score high on openness to change values should be more likely to take cyber risks compared to individuals who score high on conservation values who are less likely to take cyber risks. Thus, we predict that cyber risk is associated with values in the same vein as risks in other life areas, that is, openness to change values will be positively associated with cyber risk, in contrast conservation values will be negatively associated with cyber risks. We also hypothesize that self-enhancement values and self-transcendence are not correlated with cyber risk taking.

## Our Analysis and Results

In this paper, two hundred and fifty-nine Israeli University students participated in our laboratory study.

## Domain-Specific Risk-Taking (DOSPERT)

We first created and added six cyber-risk items to the well-known Domain-Specific Risk-Taking (DOSPERT) scale [25]. DOSPERT is a scale that assesses risk taking in five domains: financial decisions, health/safety, recreational, ethical, and social decisions.

However, the domains of DOSPERT are based on literature review that was conducted twenty years ago therefore, cyber-security risks were not included in the original version [26]. Hence, we developed six cyber-risk items to add to the DOSPERT scale. The items were adapted from Hadlington [2].<sup>7</sup> We chose the cyber items so that each relates to potentially different cyber-attack, i.e., unsafe downloading, unsafe management of passwords, and revealing sensitive information and so on.

We first show similar to the other five domains examined by the scale (Health, Ethical, Financial, Recreational, and Social) that the cyber items we employ form a separate cluster in the case of our laboratory study. This is essential in order to apply the DOSPERT scale in our analysis.

<sup>4</sup>The Schwartz theory has been consistently confirmed in cross-cultural research studies over three decades. See for example [21-23]. Several authors found that values are generally stable over time. Stability means that values are particularly useful in studying individual differences in risky behavior.

<sup>5</sup>The Schwartz circumflex (circle) of values is shown in Figure 1. The figure illustrates the dynamic structure of relations among values. Conflicting values are located in opposing directions around the circle. For any two values, the closer they are on circle, the more similar they are in the motivations they express.

<sup>6</sup>See Table 1 in the Appendix. All Tables and Figures are in the Appendix..

<sup>7</sup>Hadlington [2] was interested in the relationship between characteristics/traits and cyber risk.

Kharlamov et al. also develop a DOSPERT measure for cybersecurity [27]. Their research question is very different from ours. They are primarily interested in the validity of the measure they develop. They show that the relationship between type (relaxed, anxious, opportunistic, and ignorant) and attitude towards risk is as expected. This provides a validation of their cyber DOSPERT measure. We, of course, are interested in a very different question, the relationship between values (which are different from characteristics) and risk. But the validation of the measure Kharlamov et al. develop is important for our research since four out of our six cyber risk questions overlap with theirs [27]. Indeed, even if we eliminate the two questions that do not overlap with theirs, our results are unchanged. This provides additional external validity for the measure we develop.<sup>8</sup>After completing the DOSPERT scale survey, the students completed the Schwartz Value Scale (SVS).

Then we conduct regression analysis and show that, after controlling for personality traits (or characteristics,<sup>9</sup> the value “conservation” is negatively (and significantly) associated with cyber risk taking. Individuals who score high on this value are less likely to take cyber risks. This effect is significant at the 99 percent level of confidence.

The regression also shows that, after controlling for personality traits, the value “openness to change” is positively (and significantly) associated with cyber risk taking. Individuals with high scores on openness to change values are more likely to take cyber risks. This effect is significant at the 99 percent level of confidence.

Thus, in the case of cyber risk, even after controlling for key personality traits, the higher-order values are significantly associated with increased cyber risk taking.

We then examined the relationship between values and risk for the other five realms (health, ethics, financial, social, recreation) included in the original DOSPERT scale. We find that in all six cases (health, ethics, financial, social, recreation, and cyber), the value conservation is negatively associated with risk taking and this effect is statistically significant at the 95 percent level. Further, the value “openness to change” is positively associated with risk taking and is statistically significant at the 95 percent level in all realms with the exception of social risk. Traits, on the other hand, do not show such a stable association with risk across realms. This stability suggests that values may be better than traits/characteristics in predicting risk. This issue needs further examination, but it is interesting, nonetheless.

## Methodology

There were 259 participants in the study, of which 195 were women and 64 were men. All were Israeli undergraduates at Universities and Colleges in Israel. The mean age of the participants was 30.8 and the ages ranged from 18-60.<sup>10</sup> All participants filled in three surveys that we now describe.<sup>11</sup>

Participants completed the short version of the Schwartz Values Survey (SVS, Schwartz, 1992), which includes forty-six items. Participants rated the importance of each of these forty-six items on a 9-point scale, ranging from “opposed to my values” (-1) to “of supreme importance” (7).<sup>12</sup> The forty-six items are then grouped into the ten value types. See Table 1 for the ten value types and the items they include.<sup>13</sup>

We then, as is typical, grouped these ten values into four broader categories: (i) Openness-to-Change (ii) Conservation or Conservatism (iii) Self-Enhancement and (iv) Self-Transcendence. See Table 1.

In all four categories, we calculated the value of Cronbach’s alpha, which is a measure of internal consistency, that is, how closely related a set of items are as a group. For the grouping of the values into these four categories to be reliable, Cronbach’s alpha should be relatively high. In our data, the values for the Cronbach alpha are respectively (i)  $\alpha = .817$ , (ii)  $\alpha = .832$ , (iii)  $\alpha = .734$ , and (iv)  $\alpha = .819$ . The relatively high values of the Cronbach’s alpha means that the items in the category received similar values in our data, and that the four “broad category” grouping of values is appropriate.

<sup>8</sup>The two items that we drop in this robustness analysis are “storing personal information or sensitive data in the cloud” and “entering personal information during website registration or when shopping online”.

<sup>9</sup>We discuss traits in detail in the methodology section.

<sup>10</sup>In Israel, the average age of undergraduate students is much higher than that in the U.S. This is because Israelis typically serve in the army and travel around the world before entering college. Additionally, there are a non-trivial number of “older” undergraduate students in the study. This is due to a worldwide trend where people often return to study at universities later in life. The wide range of participant ages enhances the validity of this research.

<sup>11</sup>All surveys were translated into Hebrew.

<sup>12</sup>Choosing zero on this scale means not important at all.

<sup>13</sup>The SVS has been validated many times across different cultures and hence is appropriate for our use [28].

### Controlling for Personality Traits

Although values and traits share similarities in their nature and their content, they are two separate constructs [29,15].<sup>14</sup> Hence, we include traits in the analysis in order to examine whether values are associated with cyber risks after controlling for traits. That is, our question is whether after controlling for traits, are values associated with taking cyber risks?

Table 2 presents the definitions of traits from the Five-Factor Model (FFM), which is the most prominent model used to study values-traits relations [31,15].

We measured the five personality factors with Saucier's Big-Five personality traits survey [32]. The scale in this survey consists of 40 traits for five broad personality factors: Agreeableness, Conscientiousness, Extraversion, Neuroticism, and Openness to Experience. Participants were asked to indicate how well the 40 different traits (adjectives) describe their personality on a 5-point scale ranging from 1 (very uncharacteristic of me) to 5 (very characteristic of me). The 40 traits included in the analysis and their grouping into the big five traits are shown in Table 2.

### Risk-Taking Attitude Survey

The tendency to take risks was assessed using the Hebrew version of the DOSPERT scale which was translated to Hebrew [33]. Participants rated the likelihood that they would participate in different risky behaviors on a seven-point scale, from extremely unlikely (1) to extremely likely (7). The DOSPERT scale assesses risk attitude in five "content" domains, each of which includes 5-7 items. The content domains and their respective Cronbach's alpha are as follows:

1. Financial ( $\alpha = .713$ ),
2. Health/safety ( $\alpha = .665$ ),
3. Recreational ( $\alpha = .836$ ),
4. Ethical ( $\alpha = .517$ ), and
5. Social ( $\alpha = .65$ ).

To assess risk attitudes for cyber decisions we built a new content domain by developing six novel cyber-risks items to be include in a newly created cyber risk category. The relatively high Cronbach's alpha score ( $\alpha = .728$ ) for the cyber items means the grouping of the six items together in a domain is appropriate. See Table 3 for all of the items in the six categories.

Recent evidence from DOSPERT's meta-analysis research shows variability of Cronbach's alpha score across domains. Specifically, the Cronbach average  $\alpha$  values are lower for Social, Health and Ethical, and the higher for Recreational and Financial, respectively [34]. The Cronbach's  $\alpha$  values in this study show the same pattern, with the highest values for Recreational and Financial, and lower values for the other three categories. Importantly, for our study. The Cronbach's  $\alpha$  value for the new Cyber domain is very high: It is below that of Recreation, but above the Cronbach's  $\alpha$  value for the other four domains.

<sup>14</sup>Values, unlike traits or attitudes, are inherently desirable [30].

<sup>15</sup>See [35] for discussion on MDS analysis.

<sup>16</sup>Further, the correlations between cyber risk and the other five risk measures are relatively low and they all fall between 27 and 50 percent.

### Analysis and Results

#### MDS Analysis: Are our Groupings of Values and Measures Appropriate?

Before examining the relationship between values and risk-taking, we employed a multidimensional scaling test<sup>15</sup> (MDS) to our data sets in order to further examine whether our groupings of values and risks are appropriate. MDS serves as a measurement of similarity among groups of items and is commonly used to reduce the complexity of a data set, permitting visual appreciation of the underlying relational structures contained between items and groups of items.

The outcome of MDS analysis is a 'map' where similar items are located in proximity to one another, and dissimilar items are located proportionately further apart. A high proximity of items from the same dimension indicates that these items represent the same content and can be grouped together [36]. MDS analysis provides a systematic way to determine if the clustering of items in MDS space corresponds with theoretically established groups.

In the case of the ten values, the MDS analysis tests if our data converges to the circumflex structure [37]. In other words, the analysis tests whether the grouping of the ten values into four broader value classes is appropriate.

This analysis uses a starting configuration from a design matrix that is based on Schwartz's theoretical model (Figure 1). Each variable has been assigned to its coordinates in the prototypical structure, and the MDS algorithm started from this configuration. Figure 2 shows that our ten values mapped into the expected "circumflex structure." Thus, we find that the grouping of the ten values into the "four higher-order" values [(i) Openness-to-Change (ii) Conservatism (iii) Self-Enhancement and (iv) Self-Transcendence] is appropriate.

To examine the DOSPERT structure, we then conducted a Euclidean metric MDS as implemented by PROXSCAL with random starting configurations of 1,000 repetitions [38]. Similar to the analysis with values, the question is whether the 36 items of the DOSPERT mapped into the six higher-order risk groups (Health, Financial, Social, Ethical, Recreation, and Cyber.) See Table 3. Figure 3 shows that (with the exception of Health dimension,) the DOSPERT items from the same higher-order dimension mapped into distinct areas.

Moreover, and critical for the analysis, the new cyber items that we developed mapped into a distinct area. This is very important for our research. The implication of the distinct region means that cyber-risk is not a proxy for other the realms (ethical, financial, health, recreational, and social).<sup>16</sup>

Hence, this provides further evidence that (I) the grouping of the ten values into four broader value classes and (II) the grouping of the 36 DOSPERT items into the six higher order risk groups are appropriate for our analysis. We can now examine the relationship between values and risk, in particular cyber-risk.

## The Relationship between Values and Risk in General and Cyber Risk

Our focus is on the relationship between values and (I) risk in general vs (II) cyber risk. Hence, we take the average of the DOSPERT's five original content domains (all items except the new cyber items) to be the "general" risk-taking measure.<sup>17</sup>

Descriptive Statistics are presented in Table 4a. The correlation table (Table 4b) shows that, as predicted, openness to change values are positively correlated with risk-taking, both in the general domain and in the cyber domain. Conservation values, on the other hand, are negatively correlated with risk-taking, both in the general domain and in the cyber domain.<sup>18</sup>

As expected, risk-taking attitude did not correlate with self-enhancement and self-transcendence values. The correlations between these two higher-order values with the two risk measures are less than 0.06 in absolute value and not significantly different from zero.

### Regression Analysis

We next conducted regression analysis, in which the dependent value is the tendency to take risks: We use the DOSPERT value for cyber risk as the dependent variable. Independent variables of interest are the two higher-order values - openness to change and conservation. Control variables include gender, age, and two of the "Big-Five" traits: "Openness to Experience" and "Conscientiousness" traits. We include these traits since they are most similar in their content and associated with the values central to our investigation—Openness to Change and Conservation (respectively).

Table 4b shows that conscientiousness is positively correlated with conservation values and negatively correlated with openness to change values. Openness to experience is positively correlated with openness to change and negatively correlated with conservation values. But these correlations are not very high.<sup>19</sup> Hence, we include these traits in the regressions as well.

The first regression in Table 5 uses the cyber risk DOSPERT score as the dependent variable. The results show that both conservatism (the value) and conscientiousness (the trait) are negatively correlated with cyber risk taking. Individuals with high scores of this trait or value are less likely to take cyber risks. These effects are both statistically significant at the 99 percent level.

Further, the regression shows that openness to change (the value) is positively associated with cyber risk taking. Individuals with high scores of this value are more likely to take risks. This effect is also statistically significant at the 99 percent level. The trait "Openness to Experience" is not significantly associated with cyber risk.

<sup>17</sup>This average consistency score across the five domains is often used in this manner [39].

<sup>18</sup>Consistent with the circular structure of the ten values, the patterns of correlations formed a clear sinusoid curve, in which the most positive correlations were with openness to change values, and most negative with conservation values. The remaining correlations were in between, following their postulated order around the values circle. (See Figure 4.) The pair-wise Spearman correlations also support the sinusoid curve hypothesis, that is, the pattern of correlations between cyber risk-taking and personal values is highly similar to the correlations' patterns of values with other risk-taking domains (.76, .87, .9, .98, and .86 in the Social, Ethical, Financial, Health, and Recreational domains, respectively, all  $p < .001$ ), in other words, in terms of associations with values, cyber risk is not different from any other risks, the top peaks of the values curves are with openness to change values (self-direction or stimulation) and the bottom peaks are with conservation values (mostly with security values).

<sup>19</sup>The correlations of values and traits in our data set are consistent with earlier findings [40-29-15]. See Table 4b.

<sup>20</sup>These regressions are available from the authors upon request. R-squared values for these regressions are similar to that obtained using cyber risk, with the exception of health, where the primary reason for the higher R-squared value is the large gender effect.

In order to examine if our results are robust, we exclude two items from the Cyber DOSPERT scale that do not appear in the Kharlamov et al. cyber DOSPERT measure: "storing personal information or sensitive data in the cloud" and "entering personal information during website registration or when shopping online" [27]. We find that our results are qualitatively unchanged. This regression is shown in the second column of Table 5.

We then examined the relationship between values and risk for the other five realms (health, ethics, financial, social, and recreation) included in the original DOSPERT scale. We find that in all six cases (health, ethics, financial, social, recreation, and cyber), the value conservation is negatively associated with risk taking and this effect is statistically significant at the 95 percent level. Further, the value "openness to change" is positively associated with risk taking and is statistically significant at the 95 percent level in all realms with the exception of social risk.

Traits, on the other hand, do not show such a stable association across realms. The trait "Conscientiousness" is negative and significant in four out of the six realms, while the trait "Openness to Experience" is only positive and significant in the case of one realm: this stability suggests that values may be better than traits/characteristics in predicting risk. This issue needs further examination, but it is interesting, nonetheless.

The regression in Table 5 shows that men are not more likely to take cyber risks than women. Gender is significant in four of the six realms, meaning that other things being equal, men are more likely to take risks in these realms. Ethics is the only other exception. In the cases of cyber risk and ethics risk, controlling for other factors, there is no difference between men and women and their attitudes to risk.<sup>20</sup> This issue needs further research as well.

### Further Discussion

Our results illustrate the usefulness of values in revealing the motivational functions of cyber risk-taking, and point to possible values-based interventions in increasing cyber-security. People who place more importance on openness to change values (they are more vulnerable to risky cyber behavior) can be targeted to take part in cyber security intervention programs. Additionally, one can use "conservation" values to prompt end users to produce safe cyber behavior and reduce risky cyber behaviors. For example, before choosing password to their PayPal account, users could be asked by the system why it is important for them to lock their doors (A typical answer may be: to keep my family safe). This may induce them to choose a stronger (and unique) password in order to keep their money safe, rather than simply using their Netflix password.

**Declarations**

**Ethics Approval, Consent to Participate and Consent for Publication:** We received ethics approval and consent to participate, and consent for publication.

**Competing Interests:** There are no competing interests.

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**Data:** Summary data are available upon request.

**Note:** Sonia Roccas (Open University of Israel) passed away while we were working on this paper. Her creativity, brilliance and dedication made this project possible. This paper is dedicated to her (blessed) memory.

**Appendix**

**Table 1: Definitions of Types of Values<sup>21</sup>**

Ten Value Types	Broad Categories
<b>Universalism (UN):</b> Understanding, appreciation, tolerance and protection of the welfare of all people and of nature (broadminded, wisdom, social justice, equality, a world at peace, a world of beauty, unity with nature, protecting the environment)	Self-Transcendence
<b>Benevolence (BE):</b> Preservation and enhancement of the welfare of people with whom one is in frequent personal contact (helpful, honest, forgiving, loyal, responsible)	
<b>Tradition (TR):</b> Respect, commitment and acceptance of the customs and ideas that traditional culture or religion provide the self (humble, accepting my portion in life, devout, respect for tradition, moderate)	Conservatism/ Conservation
<b>Conformity (CO):</b> Restraint of actions, inclinations, and impulses likely to upset or harm others and violate social expectations or norms (politeness, obedient, self-discipline, honoring parents and elders)	
<b>Security (SE):</b> Safety, harmony and stability of society, of relationships, and of self (family security, national security, social order, clean, reciprocation of favors)	Self-Enhancement
<b>Power (PO):</b> Social status and prestige, control or dominance over people and resources (social power, authority, wealth)	
<b>Achievement (AC):</b> Personal success through demonstrating competence according to social standards (successful, capable, ambitious, influential)	
<b>Hedonism (HE):</b> Pleasure and sensuous gratification for oneself, pleasure, enjoying life)	Openness to Change
<b>Stimulation (ST):</b> Excitement, novelty, and challenge in life (a varied life, an exciting life)	
<b>Self-direction (SD):</b> Independent thought and action-choosing, creating, exploring, creativity, freedom, independent, curious, choosing own goals)	

<sup>21</sup>The items in parenthesis are the specific values that used to measure each of the ten values.

**Table 2: Definitions of the Five Higher Order Traits<sup>22</sup>**

Five Factor Model (FFM)
<b>Extraversion (E):</b> the tendency to be sociable, talkative, assertive, and Active vs. to be retiring, reserved, and cautious (bashful, bold, energetic, extraverted, quiet, shy, talkative, withdrawn).
<b>Agreeableness (A):</b> the tendency to be good-natured, complaint, modest, gentle, and cooperative vs. to be ruthless, suspicious, and inflexible (cold, cooperative, harsh, kind, rude, sympathetic, unsympathetic, warm).
<b>Conscientiousness (C):</b> the tendency to be careful, responsible, organized, and scrupulous vs. to be irresponsible, disorganized, and unscripted (careless, disorganized, efficient, organized, practical, sloppy, systematic).
<b>Neuroticism (N):</b> the tendency to be anxious, depressed, angry, and insecure vs. to be calm and emotionally stable (envious, fretful, jealous, moody, relaxed, temperamental, touchy, unenvious).
<b>Openness to Experience (O):</b> the tendency to be intellectual, imaginative, sensitive, and open-minded vs. to be down-to-earth, insensitive, and conventional (complex, deep, creative, imaginative, intellectual, philosophical, uncreative, unintellectual).

<sup>22</sup>The items in parenthesis are the specific adjectives that are used to measure each of the five traits/factors.

**Table 3: Domain-Specific Risk-Taking (DOSPERT) Scale<sup>23</sup>**

For each of the following statements, please indicate the **likelihood** that you would engage in the described activity or behavior if you were to find yourself in that situation. Provide a rating from *Extremely Unlikely* to *Extremely Likely*, using the following scale:

1	2	3	4	5	6	7
Extremely Unlikely						Extremely likely

1. Admitting that your tastes are different from those of a friend. (S)
2. Going camping in the wilderness. (R)
3. Betting a day’s income at the horse races. (FG)
4. Storing personal information or sensitive data in the cloud (Google Drive/Dropbox). (C)
5. Investing 10% of your annual income in a moderate growth diversified fund. (FI)
6. Drinking heavily at a social function. (H)
7. Taking some questionable deductions on your income tax return. (E)
8. Disagreeing with an authority figure on a major issue. (S)
9. Downloading free anti-virus software from an unknown source. (C)
10. Betting a day’s income at a high-stake poker game. (FG)
11. Having an affair with a married man/woman. (E)
12. Passing off somebody else’s work as your own. (E)
13. Going down a ski run that is beyond your ability. (R)
14. Investing 5% of your annual income in a very speculative stock. (FI)
15. Entering personal information during website registration or when shopping online. (C)
16. Going whitewater rafting in the spring when the river is flowing very fast. (R)
17. Betting a day’s income on the outcome of a sporting event (FG)
18. Engaging in unprotected sex. (H)
19. Revealing a friend’s secret to someone else. (E)
20. Driving a car without wearing a seat belt. (H)
21. Investing 10% of your annual income in a new business venture. (FI)
22. Giving out my passwords to another person. (C)
23. Taking a skydiving class. (R)
24. Riding a motorcycle without a helmet. (H)
25. Choosing a career that you truly enjoy over a more secure one. (S)
26. Sharing personal information through social networks/forums. (C)
27. Speaking your mind about an unpopular issue in a meeting at work. (S)
28. Sunbathing without sunscreen. (H)
29. Bungee jumping off a tall bridge. (R)
30. Piloting a small plane. (R)
31. Walking home alone at night in an unsafe area of town. (H)
32. Downloading digital media (e.g., films, music) from unlicensed sources. (C)
33. Moving to a city far away from your extended family. (S)
34. Starting a new career in your mid-thirties. (S)
35. Leaving your young children alone at home while running an errand. (E)
36. Not returning a wallet you found that contains \$200. (E)

**E = Ethical, FI = Financial Investing, FG = Financial Gambling, H = Health, R = Recreational, and S = Social, C=Cyber.**

**Table 4a: Summary Statistics**

	Mean	Std. Dev.	Min	Max
DOSPERT_Total	3.11	1.23	1.00	6.50
DOSPERT_Cyber	2.95	0.75	1.37	5.20
Age	30.76	9.14	18.00	60.00
Gender	0.25	0.43	0.00	1.00
Conservation (V)	4.32	1.02	0.52	6.63
Conscientiousness (T)	3.89	0.58	1.88	5.00
Openness to Change (V)	4.36	1.04	1.23	6.87
Openness to Experience (T)	3.86	0.58	2.25	5.00

**Note:** The Cap letters in parenthesis mark whether the variables are values (V) or traits (T)

<sup>23</sup>Our DOSPERT risk variables are calculated as “8 – scale” so that a positive correlation between a value and the DOSPERT risk variable means that this value is associated with more risk taking.

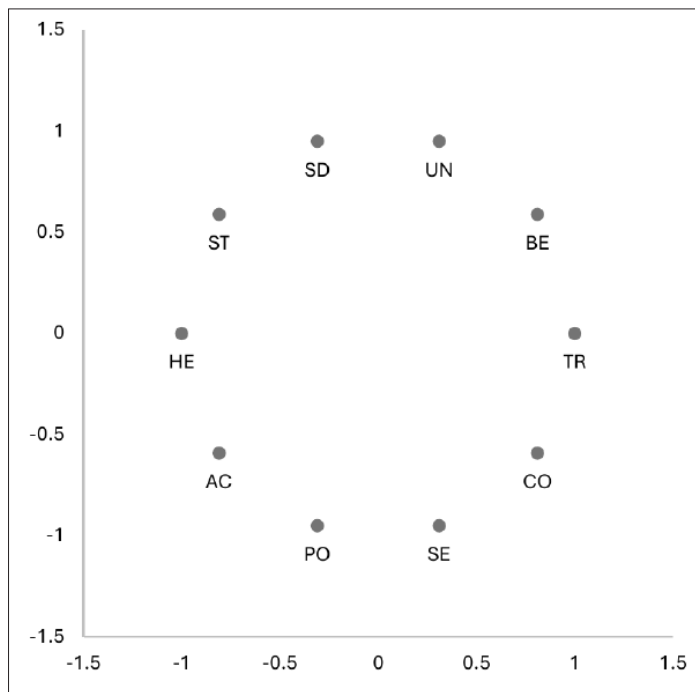
**Table 4b: Correlations among Variables**

	General Risk	Conservation (V)	Conscientiousness (T)	Openness to Change (V)	Openness to Experience (T)
General Risk	1.00				
Conservation (V)	-0.38	1.00			
Conscientiousness (T)	-0.35	0.30	1.00		
Openness to Change (V)	0.23	0.20	-0.10	1.00	
Openness to Experience (T)	0.27	-0.12	-0.05	0.20	1.00

**Table 5: Regression Results: Dependent Variable DOSPERT Cyber Risk<sup>24</sup>**

Dependent Variable	Cyber Risk (all six questions included)	Cyber Risk (excluding two questions)
Independent Variables		
Age	-0.0066 (0.0081)	-.0062 (0.0079)
Gender	0.26 (0.17)	0.11 (0.18)
Conservation (V)	-0.24*** (0.079)	-0.20** (0.082)
Conscientiousness (T)	-0.42*** (0.13)	-0.50*** (0.14)
Openness to Change (V)	0.20*** (0.074)	0.17** (0.081)
Openness to Experience (T)	0.046 (0.12)	0.049 (0.12)
R2	0.16	0.14
Adjusted R2	0.14	0.12
N	259	259

\*\*\*= significant at 99% level, \*\*= significant at the 95% level, and \*= significant at the 90% level.



**Figure 1: Schwartz Ten Value Types and Starting Configuration for the “Values” MDS Analysis**

<sup>24</sup>Standard Errors are in parentheses. The results are virtually identical if we use robust standard errors.

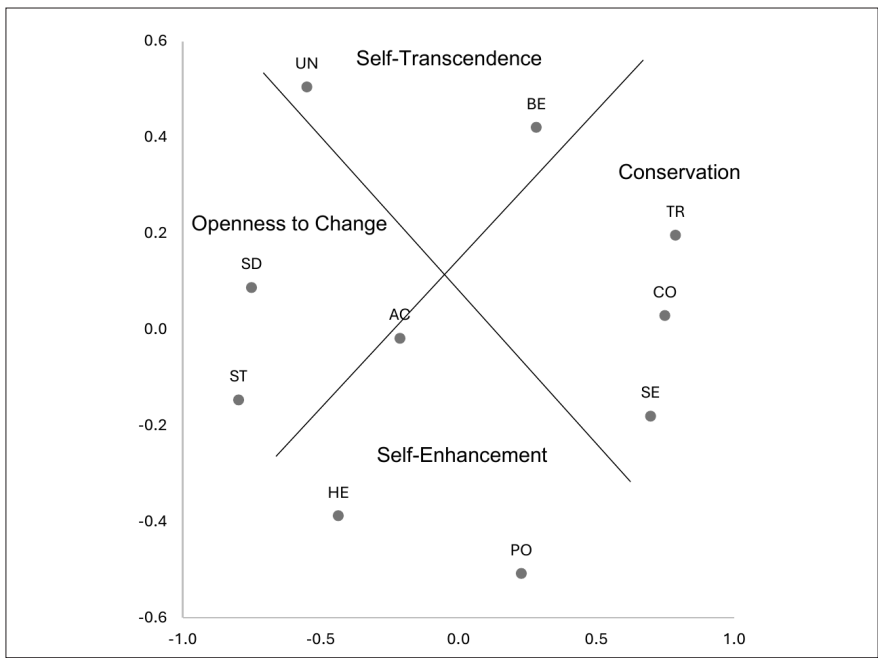


Figure 2: Display of Two-Dimensional Ordinal MDS of SVS Scores

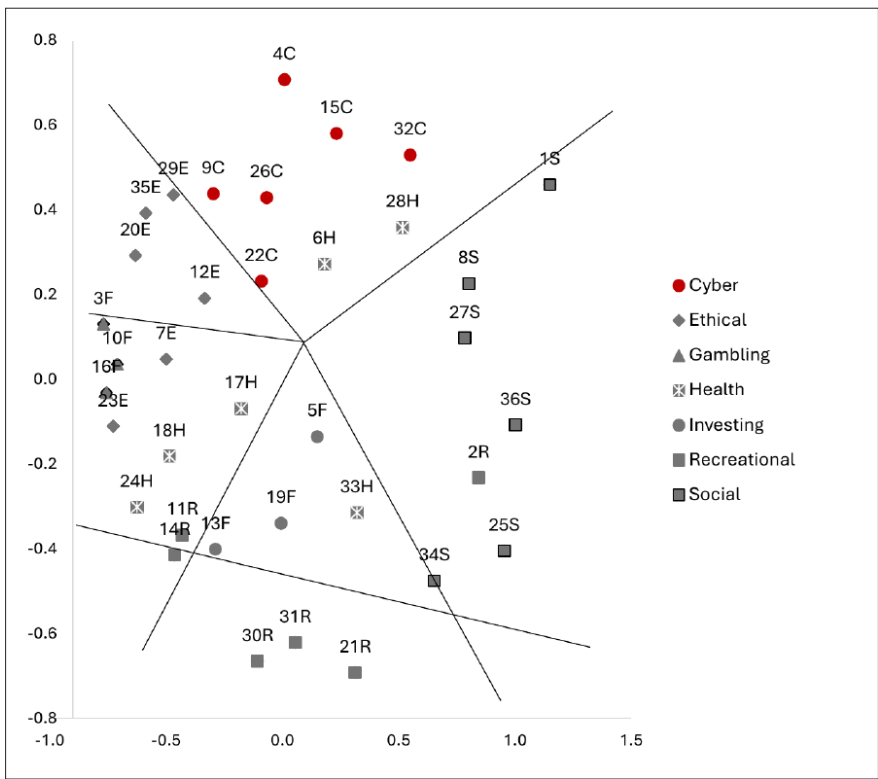


Figure 3: Display of Two-Dimensional MDS map for the DOSPERT Items

**Note:** Each point (geometric shape) in the plot (defined by two coordinates) represents a DOSPERT item. The points' numbers represent the chronological order of the DOSPERT's items, the points' letters represent the dimension of which the item measures (C=Cyber, E=Ethical, FG=Financial Gambling, H=Health, FI= Financial Investing, R=Recreational, and S=Social).

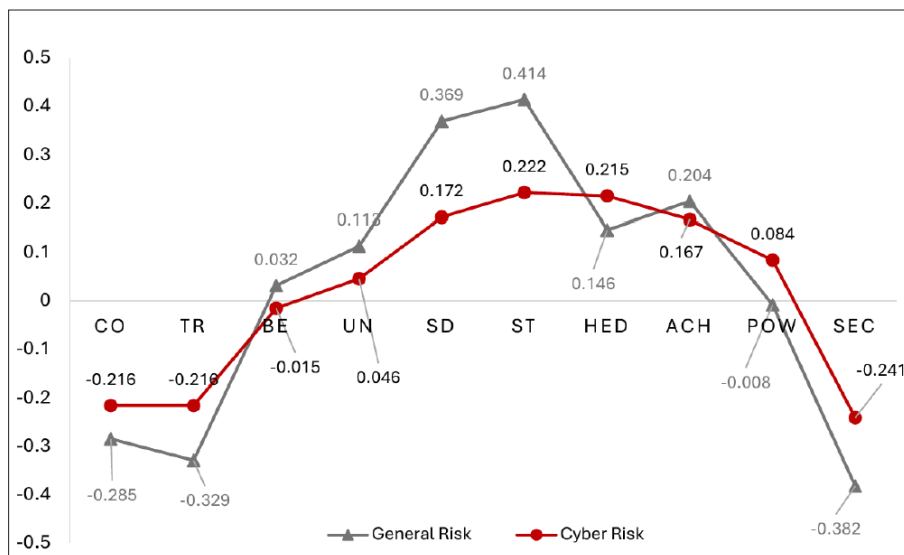


Figure 4: Correlations of Values with the Cyber Risk Domain and the General Risk Score along the Schwartz Circumplex

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