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Effects of Culture on Public Behavior Patterns in Crisis Situations

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Abstract

This paper investigates the influence of culture on public behavior patterns (PBP) in the context of cyber-physical-social systems (CPSS) during crisis situations. CPSS integrate technology and social dimensions, but the understanding and inclusion of social phenomena in CPSS development and operation are still limited. The concept of public behavior pattern (PBP) is proposed to describe recurrent behaviors of communities. The paper focuses on the cultural domain and explores how cultural dimensions, based on Hofstede's theory, could affect behavioral patterns in crisis situations. The study examines the cultural dimensions of Power Distance, Uncertainty Avoidance, and Individualism versus Collectivism in three groups: native Estonians in Estonia, Russian minority group in Estonia, and native Russians in Russia. The findings highlight differences between the cultural groups, emphasizing the importance of cultural context in crisis behavior.

1 Introduction

Cyber-physical-social systems (CPSS) are all-encompassing, intended to improve our lives, increase the safety and performance of complex processes, facilitate the operation of complex machinery, monitor and control dynamic processes, support situation management for disaster relief and recovery, to name just a few applications. This has introduced a new challenge in today's technology-integrated environments, how to adequately describe inherent social dimension in CPSS. The consideration of social phenomena in the concept of CPSS has appeared in scientific literature as an idea for some time now [12, 6]. However, the real consideration and inclusion of these phenomena in the development and operation of CPSS systems remains largely unexplored [48, 47], and substantive solutions and ideas have yet to be adequately identified. To address the description of social phenomena in CPSS, we propose the term called "public behavior pattern" (PBP). PBP refers to the recurrent way of acting by a group or crowd of individuals that form a community in a public environment or setting, towards a given object or in a given situation. To describe PBP, we divide the environment surrounding the public into five major domains: culture, medicine, cyber, politics, and economy (see Fig. 1). This paper focuses on the cultural domain and explores how cultural dimensions, based on Hofstede's theory, influence behavioral patterns in crisis situations.

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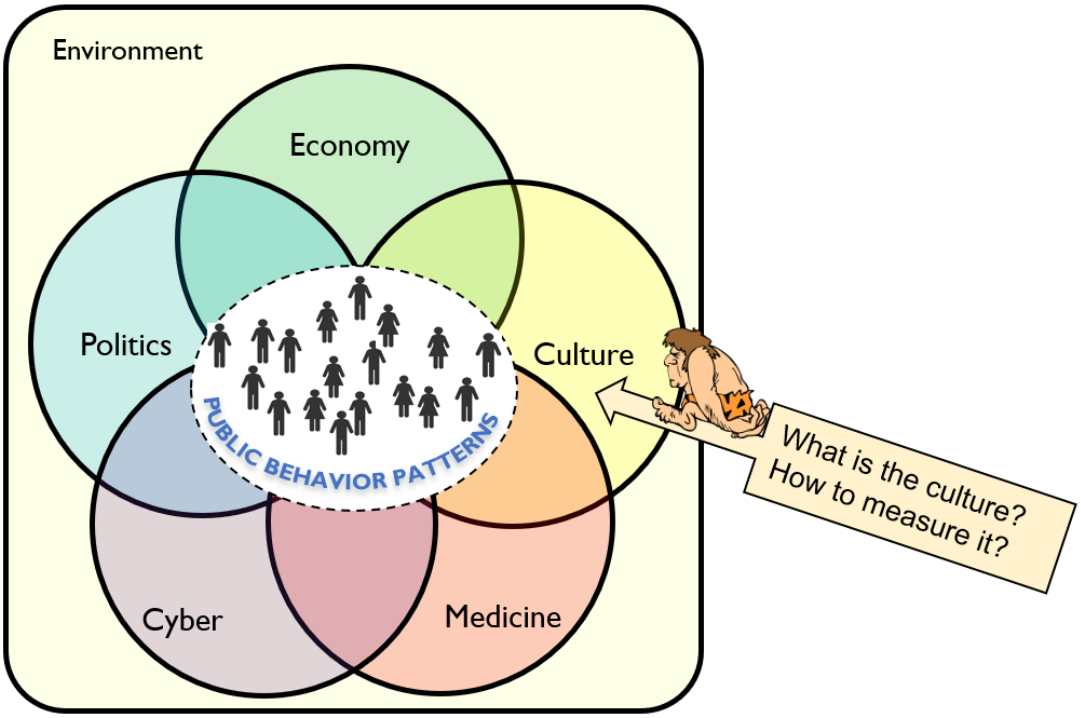

Figure 1: Major social domains within CPSS

To demonstrate the relationship between the culture and PBP, we utilize the theory of cultural dimensions developed by Hofstede [19, 20]. Our study focuses on three cultural dimensions - Power Distance, Uncertainty Avoidance and Individualism versus Collectivism. Additionally, the influence of cultural dimensions on behavior patterns is projected to crisis situations.

Based on Hofstede's work, we know that the cultural background of subgroups in the community may result in different behavior patterns compared to a social group with a different cultural background [46, 28]. Therefore, we can expect that socio-cultural aspects will play an important role in better understanding the functionalities of any artificial system involving social actors (a CPSS). For instance hazard alerts, commands and instructions should be unambiguously understood by everybody. However, designing applications for the community is a challenge (with linguistic hurdles, different ways of thinking and traditions). Hence, when considering CPSS applications, understanding behavior patterns of the public, including groups with different cultural backgrounds is highly beneficial [9].

This article analyzes empirical surveys from three distinct groups: native Estonians in Estonia (EST), the Russian minority group in Estonia (EST-RU), and native Russians in Russia (RU). The objective is to examine the influence of prevailing culture on the behavior of social actors and communities during a pandemic-induced crisis, while also acknowledging prior research on cultural context in crisis management [46, 28].

Our study highlights differences in the understanding of the situation among individuals with diverse cultural backgrounds. By considering the cultural aspects of individuals involved in crisis situations, we can better predict their reactions to received information, accounting for the influence of cultural context and anticipating behavior patterns.

2 Approaches to cultural dimensions

To avoid drawing misleading conclusions, we analyzed the findings of four prominent studies that are based on different theories of cultural dimensions. In practical point of view, we would like to find the best method for the description of cultural dimension. As the approaches taken by the authors differ, we specifically chose three cultural dimensions from each international study that overlapped with Hofstede's cultural dimensions, which are of particular interest to us. These dimensions include Power Distance, Uncertainty Avoidance, and Individualism versus Collectivism.

2.1 Hofstede's Cultural Dimensions

Hofstede's Cultural Dimensions Theory [18], [19] is one of the most well-known and widely referenced frameworks used for analyzing cultural variations between countries and regions. This theory is based on extensive research conducted by Hofstede over several decades. Furthermore, Hofstede's Cultural Dimensions Theory has become an internationally recognized standard for comprehending cultural differences.

According to Hofstede's Cultural Dimensions Theory, there are six categories that represent cultural values. These categories are Power Distance, Individualism versus Collectivism, Masculinity versus Femininity, Uncertainty Avoidance, Long-term versus Short-term Orientation, and Indulgence versus Restraint. In international studies, each country has been evaluated on a scale from 0 to 100 for each dimension [20], [21].

Based on Hofstede's cultural differences, the three most significant disparities between Estonian (EST) and Russian (RU) cultural dimensions are as follows: Power Distance, Individualism versus Collectivism, and Uncertainty Avoidance. The differences between EST and RU in the comparison of these three cultural dimensions according to Hofstede are presented in Figure 2.

According to Hofstede's studies, EST exhibits a lower Power Distance index than RU. Power Distance indicates the degree to which individuals in a culture accept an unequal distribution of power and authority. A higher Power Distance index suggests that a culture accepts inequality and power disparities, encourages bureaucracy, and demonstrates high respect for authority. In societies with high Power Distance, there tends to be a significant social gap between those in positions of authority and those who are not. People in high Power Distance societies are more likely to accept and adhere to rules and regulations established by authority figures, even if they disagree with them. Furthermore, individuals in societies with high Power Distance tend to show great respect for authority figures.

The second significant cultural dimension that exhibits a substantial difference between EST and RU, as indicated by the Hofstede indexes, is Individualism versus Collectivism. According to Hofstede's studies, EST demonstrates higher Individualism compared to RU. In societies with high Individualism, individuals value personal freedom, autonomy, and self-expression. They prioritize individual achievements, personal success, and taking personal responsibility. They are less reliant on others and prioritize their own interests over the interests of the group. In individualistic societies, interpersonal relationships tend to be informal, and decisions are often made based on individual preferences and opinions. In contrast, in societies with high Collectivism, people prioritize the needs of the group over individual needs. They value cooperation, loyalty, and harmony within the group, and strive towards collective well-being. They are more likely to rely on others and prioritize the success of the group over individual accomplishments. Interpersonal relationships tend to be more formal and hierarchical, emphasizing loyalty and commitment to the group. Decisions are typically made based on the group's interests rather than individual preferences.

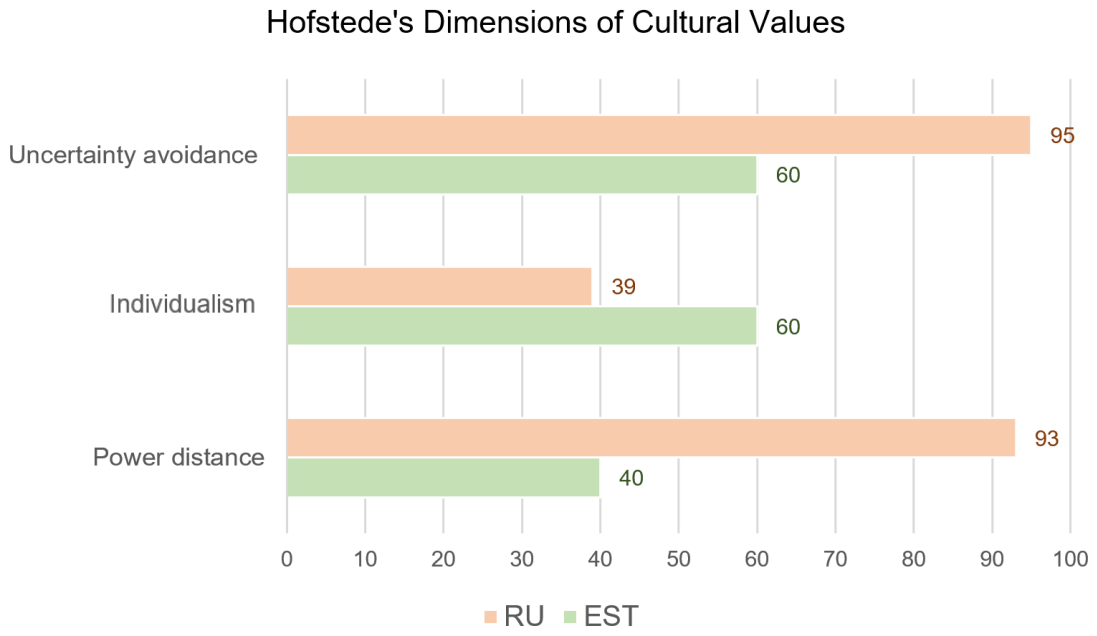

Figure 2: Differences between EST and RU according to Hofstede's cultural dimensions.

The third notable cultural dimension that differs between EST and RU, as indicated by the Hofstede indexes, is Uncertainty Avoidance. According to Hofstede's studies, RU demonstrates higher Uncertainty Avoidance compared to EST. Uncertainty Avoidance refers to the extent to which individuals in a society feel threatened by ambiguity and uncertainty. In societies with high Uncertainty Avoidance, there is a greater emphasis on formal rules and regulations. People feel more comfortable when they have clear guidelines to follow. Additionally, individuals tend to be risk-averse and prefer to adhere to familiar routines and established practices.

Numerous empirical studies have been conducted to examine the validity and reliability of Hofstede's cultural dimensions. The majority of these studies have supported Hofstede's model, although there exist some studies have raised questions regarding the validity of Hofstede's research questionnaire [40], [30], [13], [31].

2.2 The GLOBE Project

The GLOBE Project is a comprehensive study of cross-cultural leadership that encompasses more than 60 countries and cultures [22], [10], [42]. In the GLOBE project, culture is approached through nine quantitative dimensions: Assertiveness, Future Orientation, Gender Egalitarianism, Humane Orientation, Institutional Collectivism, Performance Orientation, In-group Collectivism, Power Distance, and Uncertainty Avoidance. The last three cultural dimensions in the GLOBE project align with Hofstede's cultural dimensions in the following manner: In-group Collectivism corresponds to Hofstede's Collectivism, while Power Distance and Uncertainty Avoidance share similar content and names (Fig. 3). All scales developed by the GLOBE Project range from 1 to 9.

On the Power Distance scale, RU has a higher score than EST. Higher scores indicate a greater acceptance and expectation of power and status differences within a society. It suggests

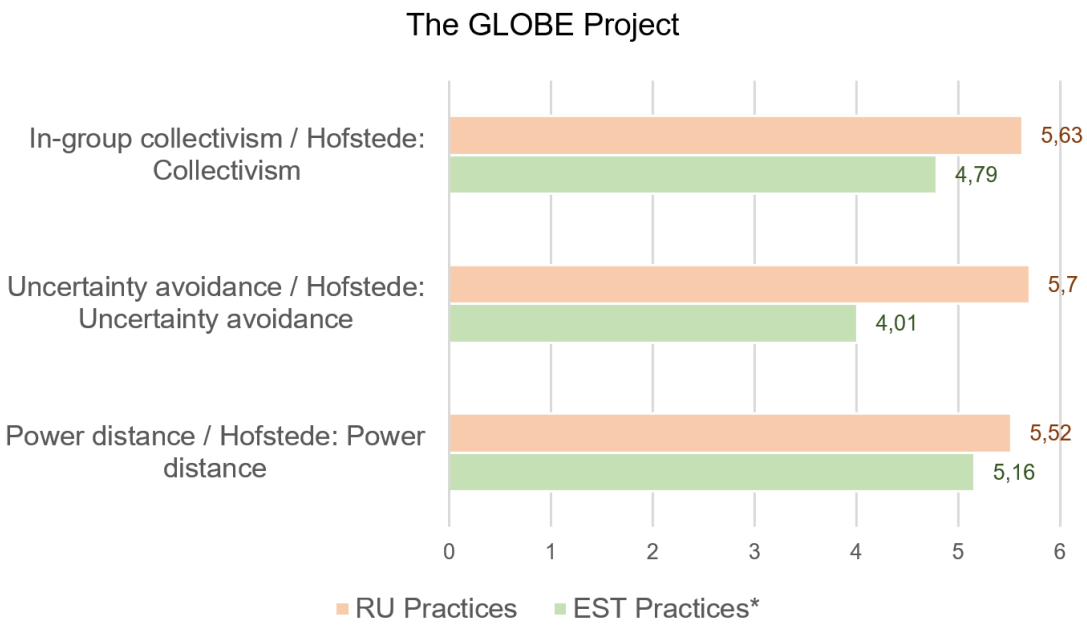

Figure 3: The most significant differences between EST and RU cultures according to the GLOBE Project. Data Source: [14, 1].

that individuals in the society are more likely to accept hierarchical structures and power differentials between individuals or groups, and are less likely to challenge authority or question the status quo. RU also demonstrates higher scores on the Uncertainty Avoidance scale. Higher scores indicate a greater discomfort with ambiguity and uncertainty, and a stronger desire for rules, regulations, and predictability in the social context. In terms of In-group Collectivism, RU has a higher score, indicating a greater emphasis on group loyalty and collective goals over individual interests.

The validity of the applied scales has been evaluated in several countries, and no significant objections have been raised [16], [3].

2.3 Trompenaars and Hampden-Turner Model

The model developed by Trompenaars and Hampden-Turner was the result of 10 years of research into the preferences and values of people from various cultures around the world. During this research, they distributed questionnaires to over 46,000 managers in 40 countries [41], [15].

The Trompenaars Hampden-Turner model incorporates seven cultural dimensions: Universalism versus Particularism, Individualism versus Communitarianism, Achievement versus Ascription, Neutral versus Affective, Specific versus Diffuse, Internal versus External Control, and Sequential versus Synchronic Time. Among these dimensions, one corresponds to Hofstede's cultural dimensions, namely Individualism versus Communitarianism, which aligns with Hofstede's Individualism versus Collectivism in terms of content (Fig. 4). All scales in the Trompenaars and Hampden-Turner model range from 0 to 100.

In terms of the Trompenaars Hampden-Turner model, EST scores lean more towards Indi-

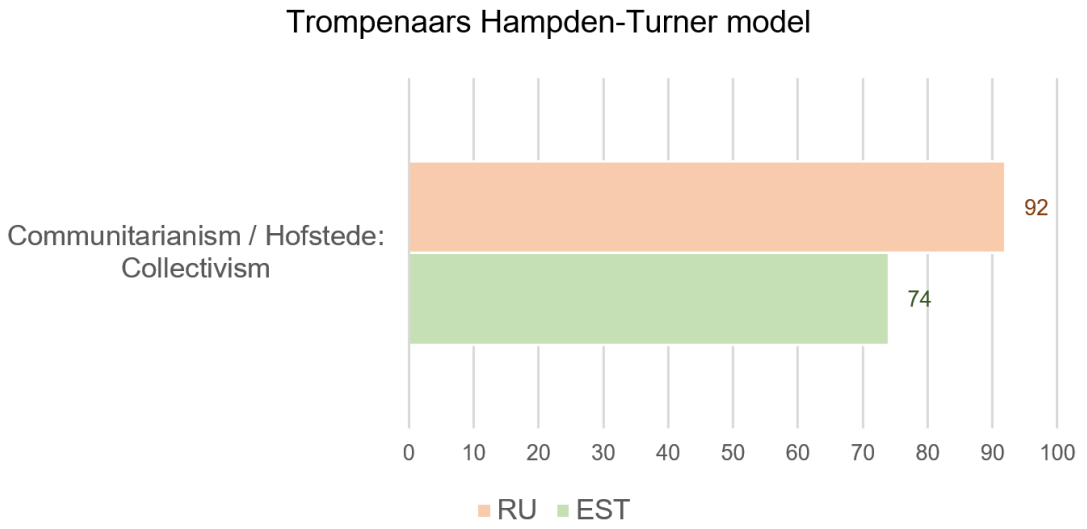

Figure 4: Trompenaars and Hampden-Turner Model.

vidualism than Communitarianism, whereas RU scores demonstrate the opposite pattern. A high score in Communitarianism indicates that individuals believe the group is more important than an individual. In such cultures, the group provides assistance and safety in exchange for loyalty, and the interests of the group always take precedence over individual interests.

Several studies have examined the validity of the scales in the Trompenaars Hampden-Turner model across different national cultures. Thus far, no significant objections have been raised regarding the validity of these scales [8], [24].

2.4 World Values Survey

The World Values Survey (WVS) is an international research initiative that explores people's values across different countries and societies. The primary method of data collection in the WVS survey is face-to-face interviews conducted at respondents' homes or places of residence. The respondents' answers are recorded on paper questionnaires or through Computer Assisted Personal Interviews. The WVS covers a total of 111 countries and societies, employing nationwide random probability representative sample designs with sample sizes ranging from 1000 to 3200 respondents.

Interestingly, according the literature, Hofstede's Uncertainty Avoidance index is strongly correlated with skepticism [29, 2]. Empirical evidence supports the notion that the WVS scale of Secularism-Rationality corresponds to Hofstede's scale of Uncertainty Avoidance in terms of content (Fig. 5).

WVSs have been conducted regularly, including seven studies in RU between 1990 and 2018 and six studies in EST during the same period. As the dates of the studies in EST and RU did not coincide exactly, we calculated the average of both sets of data to ensure an objective assessment.

In terms of Secular-Rational values, EST scored higher than RU. A higher score on the Secularism-Rationality scale indicates a preference for secular, rational, and scientific values and beliefs over traditional religious or supernatural ones.

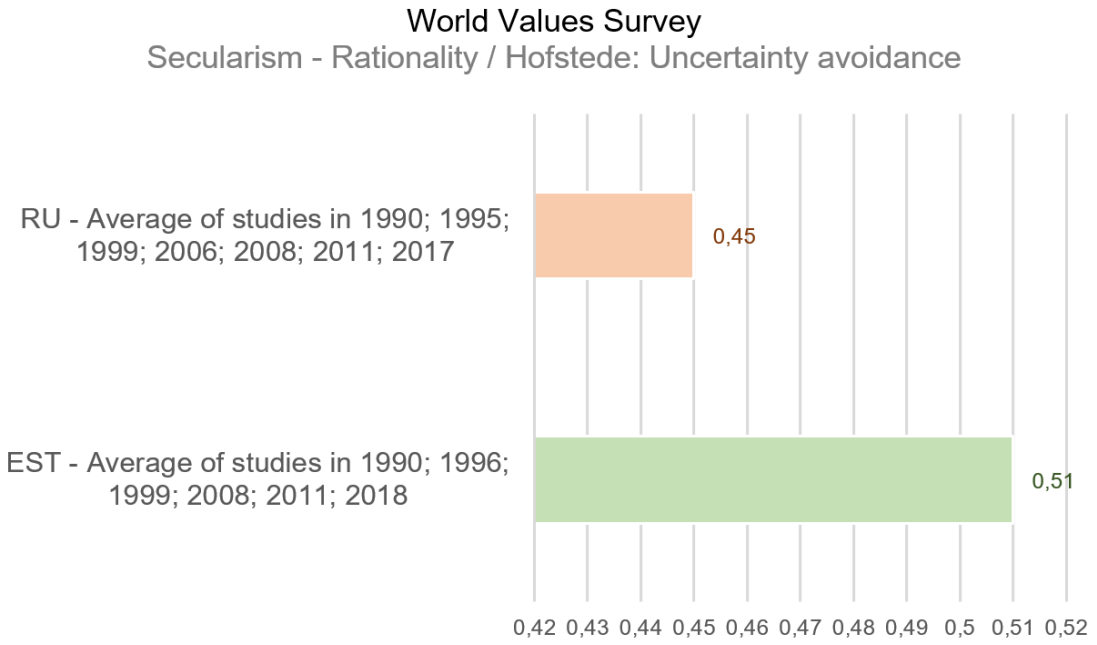

Figure 5: World Values Survey.

The validity of the cultural dimensions used in the WVS has been the subject of discussion in various cross-cultural studies [17], [38], [4].

3 Public Behavior Patterns in Crisis Based on Cultural Dimensions

3.1 Power Distance Behavior in Crisis

Manifestations of high Power Distance in society include:

1. hierarchical society and organizational structures;
2. high respect for authority figures;
3. acceptance of rules and regulations;
4. formal communication;
5. paternalistic leadership.

Individuals living in societies with higher Power Distance are more likely to seek guidance and direction from authority figures during times of crisis. They are more inclined to accept decisions made by those in power and are less likely to question or challenge them. They are also more prone to adhering to established protocols and procedures, even if they appear inefficient or ineffective.

On the other hand, in societies with low Power Distance, individuals are more willing to actively participate in crisis response. They are more inclined to express their opinions and ideas, even if they contradict those of authority figures. Additionally, they are more inclined to question established protocols and procedures, seeking out alternative approaches and solutions.

3.2 Individualism versus Collectivism Behavior in Crisis

Manifestations of high Collectivism in society include:

1. hierarchical society and organizational structures;
2. collectivism;
3. formal and hierarchical interpersonal relation-ships;
4. decision making based on the interests of the group;
5. communication style is reserved, with being more cautious about expressing own opinion;
6. work ethic prioritize group harmony and stability, to adhere to established rules and traditions.

During a crisis, individuals in Individualistic cultures are more likely to prioritize their own safety and well-being. They may take actions to protect themselves and their immediate family or social network, rather than focusing on the needs of the larger group. Competitive or individualistic behaviors, such as hoarding resources or prioritizing personal survival over that of others, may also be more common.

In contrast, in Collectivistic cultures, individuals are more inclined to prioritize the needs of the group over their own. They are more willing to make sacrifices for the greater good of the community and are more likely to collaborate and work together to solve problems and overcome challenges. Sharing resources and supporting one another take precedence over individual needs in such cultures.

3.3 Uncertainty Avoidance Behavior in Crisis

Manifestations of high Uncertainty Avoidance in society include:

1. formal rules and regulations;
2. collectivism;
3. risk aversion and preference to stick to familiar routines and established practices;
4. emotional expression lower;
5. less tolerance of ambiguity;
6. time orientation on the past and the present;
7. greater respect for authority figures and experts.

In cultures with high Uncertainty Avoidance, individuals are more inclined to seek clear rules and guidance during a crisis. They are prepared to adhere to established standards and practices and are less likely to question or challenge them. In the face of ambiguity, they are more likely to experience worry and tension and may seek knowledge and comfort to alleviate these feelings. Conversely, in societies with low levels of Uncertainty Avoidance, people are more tolerant of ambiguity and uncertainty during a crisis. They are less concerned about adhering strictly to existing standards and processes and are more open to experimenting with novel solutions and strategies. They have a higher propensity to adapt.

4 Empirical evidence of cultural dimensions playing a role in public behavior patterns in crisis

We focus on three Hofstede's cultural dimensions that were significantly different between EST and RU i.e., Power Distance, Individualism versus Collectivism, and Uncertainty avoidance. However, in case it was possible we tried to find only those questions that show what people actually DO (wearing face masks, self-isolation etc.), not so much their willingness or attitude to do something. Despite the number of empirical studies showing correlations between Hofstede's cultural dimensions and people's behavior patterns [35], [26], [39], [45], unfortunately, this was not a straightforward task.

4.1 Trust and Tolerance Differ Among the EST, EST-RU, and RU Groups

In order to better understanding trust, professionally conducted surveys were utilized in both Estonian (EST) and Russian minority group in Estonia (EST-RU) samples [44]. For the purposes of this analysis, the combined results of two surveys were examined, with a total of 1,251 to 1,509 respondents participating in both surveys. The samples from both studies were representative of the Estonian population, ensuring that the participants were representative in terms of age, gender, and nationality (EST and EST-RU groups). In these surveys, trust in state institutions and tolerance of different viewpoints were measured. The investigation also includes data from Russia (RU) that was collected from various sources, including Russian surveys on trust [32], [49], as well as international data sources [11], [33], which were available at the same point in time.

According to literature [34], there is a significant correlation between trust and cultural dimensions. Firstly, a higher level of Power Distance may be associated with higher trust scores in a given country [23]. Secondly, a higher level of Collectivism may also be related to higher trust scores in a country [7]. Our investigation into cultural dimensions reveals that Russia (RU) has a higher Power Distance index compared to Estonia (EST). On the other hand, EST has higher Individualism than RU, while RU has higher Collectivism than EST. Empirical evidence from above mentioned sources shows that trust in the President is high in both the EST and RU groups (82% in EST vs. 83% in RU), but trust in the President is lower in the EST-RU group (46%). Trust in the Government is higher in the EST group (60%) and lower in both the RU and EST-RU groups (35% in EST-RU vs. 46% in RU). Trust in local state media is high in the RU group (86%) and lower in both the EST and EST-RU groups (47% in EST vs. 26% in EST-RU). Trust in social media is higher in the RU and EST-RU groups (68% in EST-RU and 43% in RU), but lower in the EST group (24%). Generally, trust in political institutions, including trust in media (including social media), is higher in

the RU group. However, an exception is trust in the President, where the EST group's trust is as high as in the RU group. The trust ratings of the EST-RU group show a similar trend as the RU group, but trust level itself is generally much lower. In other words, the empirical evidence suggests that higher Power Distance and higher Collectivism tend to predict higher trust. Thirdly, a higher level of Uncertainty Avoidance may be associated with a lower level of trust [25]. Our investigation into cultural dimensions reveals that RU has higher Uncertainty Avoidance than EST group. Empirical evidence shows that tolerance of different viewpoints is higher in the EST group (74%) and lower in the EST-RU group (62%), as well as tolerance of Ukrainian refugees (76% in EST vs. 57% in EST-RU). Thus, the empirical evidence suggests that higher Uncertainty Avoidance is connected to lower level of trust and tolerance, and vice versa.

These findings provide insights into the cultural dimensions and can be used to derive public behavior patterns in crisis situations.

4.2 Following Regulations in a Crisis Situation Differs Among the EST, EST-RU, and RU Groups

The COVID-19 pandemic, albeit being a tragic event, offers a unique opportunity to compare the behaviors of people of different nations and nationalities. All over the world, the methods used to avoid falling ill and stop the spread of the COVID-19 virus were mostly the same. However, the adoption and effectiveness of protective methods varied significantly from one nation to another. Our analysis focuses on the usage of various methods, such as wearing face masks, practicing physical distancing, self-isolation, and hand hygiene, in the EST, EST-RU, and RU groups. Hofstede's research indicates notable cultural differences between EST and RU in terms of Power Distance, Collectivism vs. Individualism, and Uncertainty Avoidance. Our findings align with these cultural dimensions, as we observe differences in the adoption and implementation of COVID-19 mitigation methods between the EST, EST-RU, and RU groups.

In Estonia, regular public opinion surveys were conducted throughout the pandemic to assess public opinion and behavior [43]. These self-report surveys represented 0.1% of the Estonian population (n=1250), encompassing all age groups, genders, and ethnicities (incl. EST and EST-RU groups) in appropriate proportions. To begin, we compare the behavior of Estonians (EST) and Russians residing in Estonia (EST-RU). The surveys indicate high knowledge and awareness of COVID-19 mitigation measures among both the EST and EST-RU groups throughout the pandemic (see Table 1). For example, hand hygiene practices were equally high among the EST and EST-RU groups, and there was little variation in mask usage and hand disinfection. However, greater disparities arise in adherence to physical distancing rules (limiting gatherings to no more than two people with a distance of at least 2 meters) and avoidance of public gatherings and events, with the EST-RU group displaying less enthusiasm in following these regulations. The most notable difference is observed in the practice of self-isolation, where less than a quarter of the EST-RU group report adherence compared to nearly half of the EST group.

These findings reveal two key points. First, there are minimal or no differences in following COVID-19 mitigation measures that do not involve or disrupt social interaction, such as hand hygiene and mask wearing. Second, there are significant differences in adherence to measures that disrupt normal social interaction, such as self-isolation, physical distancing rules, and public gatherings. According to Hofstede, RU exhibits a significantly higher degree of collectivism compared to EST. Social interaction and group discussions hold greater importance in Russian culture.

Unfortunately, we were unable to find representative surveys encompassing the entire population of the Russian Federation (RU group). Therefore, we present several localized surveys conducted in Russia and discuss their results in relation to our findings regarding behavioral differences between the EST and EST-RU groups living in Estonia. We found some surveys [37, 27, 36, 5] that compare RU behavior with the EST-RU and EST groups. The findings of the selected surveys are presented in Table 1.

Table 1: Compliance to COVID-19 mitigation measures in Estonia and Russian Federation (percentage of respondents agreeing).

Self report item	Estonia			Russia
	EST-RU	EST	RMSD[a]	
Awareness of measures	91,4	90,7	1,9	
Compliance	86,8	90,0	3,4	48,6[b]
Washing hands	87,0	86,3	1,4	86,7[c]
Disinfecting hands	71,5	70,2	3,9	55[c]
Wearing mask[d]	15,8	18,9	3,3	39,5[c]
Wearing mask[e]	85,8	90,6	4,8	87,6[f]97,5[g]
Avoid public gatherings	67,6	75,2	8,3	80,4[c]
Following distance rules	55,2	64,0	9,0	71,6[c]
Self-isolation	23,6	44,6	21,0	73,5[c]

[a] Root-mean-square-deviation.
[b] June 2020, source: [27]
[c] May 2020, source: [5]
[d] March to November 2020, source: [43]
[e] December 2020 to May 2021, source: [43]
[f] September to October 2020, source: [37]
[g] March 2021, source: [36]

Overall, Russia reports higher compliance to most COVID-19 mitigating measures. Washing hands and wearing masks are similar to those reported in the EST and EST-RU group surveys, while RU seem to follow distance rules and avoid public gatherings even more than EST. It is somewhat surprising that RU also report high compliance with self-isolation, much more than EST and EST-RU. A possible explanation might be that cultures with high Power Distance and Collectivism tend to better follow rules and authority.

5 Conclusions

Cyber-physical-social systems (CPSS) play a crucial role in improving our lives and addressing complex processes. However, the social dimension of CPSS has not been adequately studied or included in its development and operation. Public behavior patterns (PBP) are recurring and regular patterns of behavior exhibited by groups or crowds. Understanding PBP is essential for designing CPSS that cater to the needs and behaviors of different cultural subgroups.

The comparison of results from the four research methods: Hofstede, the GLOBE, Trompenaars and Hampden-Turner Model, and World Values Survey —- across the three cultural dimensions (Power Distance, Individualism vs. Collectivism, Uncertainty Avoidance) reveals that the results for EST and RU are consistent and distinguish cultural differences. Accordingly, RU demonstrates a higher Power Distance index compared to EST, while EST shows higher

levels of Individualism compared to RU. Additionally, RU displays higher levels of Uncertainty Avoidance compared to EST. Therefore, all four research methods are usable for assessing cultural differences and consequently, for better understanding public behavior patterns in crisis.

Empirical evidence demonstrate: (1) higher Uncertainty Avoidance predicts a lower level of trust and tolerance, and vice versa, higher Power Distance and higher Collectivism tend to predict higher trust; (2) there were found little or no differences in following those COVID-19 mitigating measures that do not involve or disrupt social interaction (washing/disinfecting hands, wearing face masks). On the other hand, there were some or significant differences in following the measures that involve the disruption of normal social interaction (self-isolation, distance rules, public gatherings).

Cultural dimensions are essential for crisis management, including the influence of media channels on community behavior and the need to consider cultural aspects in designing applications and communication strategies for multicultural communities. By understanding the influence of culture on behavior patterns, it becomes possible to predict and anticipate the reactions of different cultural subgroups in crisis situations. This knowledge can help crisis management strategies and communication approaches. Future research should continue to explore the relationship between culture and behavior in crisis situations, taking into account cultural dimensions and their impact on public behavior patterns.

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