Be Aware! Indications for Intercultural Awareness for Digital Health Innovations and Innovation Capability

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Abstract: Cultural influences on single Digital Health Innovation (DHI) processes or on a society's capability to promote DHI development and implementation remain difficult to describe and to manage on different levels of responsibility. Using Hofstede's Dimensions of National Culture, we investigated the influence of each dimension on DHI to support awareness and to derive valuable indications for both practice and research. An expert study with 23 participants representing 13 different European countries explored the influence of a nation's characteristic on how the DHI domain is supported or slowed down. The results describe indications for all six dimensions of Hofstede, but "Uncertainty Avoidance" and "Indulgence" are highlighted as the interviewees could assess their influence on DHI confidently. Combined with cultural aspects that do not rely on nationalities, our contribution can improve scientific and practice-oriented initiatives especially in context of international collaborations or of DHI for multi-national usage scenarios.

1 INTRODUCTION

Digital health changes the way healthcare is delivered by introducing "tools and services that use information and communication technologies to improve prevention, diagnosis, treatment, monitoring, and management of health-related issues and to monitor and manage lifestyle-habits that impact health" (European Commision, 2020). Various terms, topics or artefacts shall be differentiated but all have the same aim: to improve access to and quality of care and make healthcare more efficient (European Commision, 2020).

Even though expectations regarding digital health are high, studies show that various countries are not equally ready or capable of implementing digital health into their national health systems (Thiel et al., 2019). Hence, the question is to whether there is a common characteristic inherent in these countries responsible for the different levels of readiness or capability. Prior studies have investigated a variety of barriers and enablers, i.e., influential factors to Digital Health Innovation (DHI) processes and found that

culture is one of these (Kowatsch et al., 2019; Yusif et al., 2017). National culture also has a big influence on innovation capability, which in turn can increase the competitiveness of a country (Prim et al., 2017). Based on these findings, the question arises to what extent DHI processes are influenced by culture.

Culture can be defined in many ways, but Hofstede's definition by using 6 dimensions to describe a national culture is perhaps the most popular one and commonly used (Hofstede et al., 2010; Srite and Karahanna, 2006). The framework of Hofstede has been applied by many researchers to investigate a variety of domains. In particular, it has been studied how culture influences the degree of innovation of countries (Moonen, 2017; Prim et al., 2017), the innovative strength of businesses (Gallego-Álvarez and Pucheta-Martínez, 2021) or the technology acceptance of a nation (Srite and Karahanna, 2006).

The influence of culture in the domain of healthcare has been partially investigated, e.g., by integrating the cultural dimensions of Hofstede into the *Technology Acceptance Model* or the *Unified Theory of Acceptance and Use of Technology* to

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explain eHealth or telemedicine adoption and use (Hoque and Bao, 2015; Nwabueze et al., 2009). Nevertheless, these studies investigate cultural influence in the healthcare systems primarily from the patient or technology user perspective rather than from a systemic view of innovation in healthcare. Braithwaite et al. applied cluster analysis to investigate the cultural influence on the performance of health systems in certain OECD countries and conclude that cultural characteristics play an important role on this performance (Braithwaite et al., 2020). However, they focus on the performance of health systems in general and not on DHI capability.

Hence, we want to understand how and to what extent culture affects DHI processes and, consequently, a society's capability to promote DHI. This supports learning about differences between the state of DHI and provide new research questions that may result in further evidence in best practices. Our understanding of the term "DHI" is thereby process-oriented, as cultural aspects influence the way of how an innovative digital health artifact is designed, developed and implemented. We see five scenarios within the context of scaling DHI projects which are affected by cultural differences and, thus, may benefit from our investigation:

- Management of DHI projects for international usage contexts
- Management of DHI projects with cross-boarder collaborations
- Interpretation and adaption of best practices from different countries
- Design and management of international DHI spaces and programs
- Supporting the National policy making in developing and managing the legal framework for DHI implementation

Therefore, our research lies at the intersection of three topics: (digital) health, (digital) innovation, and culture. Conclusively, the following research question arises: *How do a country's characteristics of national culture influence DHI processes regarding and the related structure in DHI environments?*

To analyze this influence, we conducted a qualitative analysis. We held interviews with 23 experts from 13 European countries to get deeper insights into their health system's structure and innovation processes. This explorative approach was deemed feasible as the influence of culture on the structure and innovation capability of healthcare

systems is not yet a well-investigated topic. We provide descriptive findings in this paper and enrich the knowledge base around healthcare systems and their structure with a focus on cultural factors and DHI. This lays the groundwork for further studies investigating that topic in detail, which can derive recommendations for best practices on how to handle especially internationalization in digital health.

2 FUNDAMENTALS

2.1 Dimensions of National Culture

Culture can be defined in many ways, either based on shared values or problem solving, or by using other all-encompassing definitions (Straub et al., 2002). Hofstede's definition is "arguably the most predominantly used" (Srite and Karahanna, 2006). According to Hofstede, "culture is the collective programming of the mind that distinguishes the members of one group or category of people from others" (Hofstede, 2011). Various patterns and dimensions exist to describe the facets of culture (Straub et al., 2002), with Hofstede's dimensions of national culture being most frequently used.

Hofstede describes national culture by using six dimensions (Hofstede et al., 2010): Power Distance, Uncertainty Avoidance, Individualism vs. Collectivism, Masculinity vs. Femininity, Long-Term vs. Short-Term Orientation, and Indulgence vs. Restraint. These dimensions depict how a society's culture affects the value and behavior of its members. They are briefly described in Table 1. Based on these dimensions and through multiple cross-national and replication studies, Hofstede and other colleagues have generated a dataset that contains the value scores for the cultural dimensions for 111 countries and regions around the world. As this data set is provided on Hofstede's website, it is eagerly used for further research, despite criticism and discussion (Gaspay et al., 2009). In the following, the Hofstede dimensions are briefly described as per the Culture Compass, and as communicated to our study participants. The Culture Compass [1] is a questionnaire to assess an individual's scores regarding the cultural dimensions.

2.2 Prior Research

Some previous studies already identified an influence of Hofstede's cultural dimensions on the degree of

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[1] https://www.hofstede-insights.com/product/culture-compass/

innovation in certain countries, that we like to investigate further within the domain of DHI. For instance, Prim et al. analyzed the influence of cultural dimensions on the degree of innovation in general (Prim et al., 2017). They found a negative relation for PDI and a positive one for IDV.

Other authors investigating the role of Hofstede's cultural dimensions on (IT) adoption and innovation also concluded that a high PDI has a negative (Halkos and Tzeremes, 2013; Thatcher et al., 2003) and a high IDV a positive effect on the degree of innovation (Moonen, 2017; Yaveroglu and Donthu, 2002).

Table 1: Dimensions of national cultures (Hofstede et al., 2010).

PDI	A high value of **Power Distance** indicates a high acceptance of power being distributed unequally within a society; hierarchy is needed rather than just being a convenience. Societies with a low score in the PDI dimension put emphasis on the importance of equal rights, as opposed to the importance of privileges of the more powerful one.
UAI	A high value of **Uncertainty Avoidance** indicates a need for predictability and structure, often in the form of written and unwritten rules. Societies scoring low in the UAI dimension consider uncertainty as normal and each day is taken as it comes.
IDV	In societies with a high score in the **Individualism** dimension, there is a strong sense of "I", meaning that one's personal identity is distinct from others'. In collectivist societies (low score in IDV), there is a strong sense of "we", illustrating a mutual practical and psychological dependency between the person and the in-group.
MAS	In societies with a high score in the **Masculinity** dimension, people tend to focus on personal achievement, material success and the importance of status. In feminine societies (low scores), people are more concerned with quality of life, taking care of those less fortunate, ensuring leisure time, and finding consensus.
LTO	Societies with a high score in the **Long-term Orientation** dimension, focus on perseverance and thrift. Short-term oriented societies (low scores) emphasize respect for traditions and fulfilling social obligations.
IVR	Societies with a high score in **Indulgence** dimension reflect a positive attitude and the view that one can act as one pleases. In contrast, in restraint societies (low score) gratification of needs is regulated by strict social norms and leisure is less important.

Also, the dimensions of MAS and UAI were already found by other authors to be negatively related to the degree of innovation (Halkos and Tzeremes, 2013; Prim et al., 2017), while Moonen sees this negative connection only during the initiation phase of innovations, while a higher level of masculinity can be positively influencing when implementing innovations. Halkos and Tzerenes underline that the environment of innovations is often uncertain which is especially contradictory in countries with a high score of UAI (Halkos and Tzeremes, 2013). Moonen and Prim et al. showing that planning and optimism can be very supportive not only for innovations in general but also for DHIs and postulate a positive influence of LTO and IVR (Moonen, 2017; Prim et al., 2017).

2.3 Initial Indications of Influence

To gain insights into the status of DHI capability in different countries and whether or how this is linked to Hofstede's cultural dimensions, we related the country-specific scores of the Hofstede dimensions (values from 2015) to the country-specific values of the Digital Health Index (DH Index, values from 2018) by the Bertelsmann foundation (Thiel et al., 2019). We examined whether and to what extent the values correlate with the Hofstede values. Hofstede scores were available and originally marked as valid for all 17 countries ranked within DH Index. Table 2 presents the results of our analysis. The only significant correlation with the DH Index is regarding MAS. We interpreted this correlation only as first indication for our further research activities.

Table 2: Correlation analysis - dimensions of national culture and DH Index; significance highlighted in grey.

Dimension	Correlation & Significance	
PDI	Corr: -0,40;	p-value: 0,103
IDV	Corr: -0,05;	p-value: 0,841
MAS	Corr: -0,48;	p-value: < 0,05
UAI	Corr: -0,37;	p-value: 0,140
LTO	Corr: -0,27;	p-value: 0,295
IVR	Corr: 0,19;	p-value: 0,468

Although the amount of research on the influence of Hofstede's dimensions of national culture on DHI processes and capability is scarce, there are previous studies that identified and described their influence on innovation capability in general. Prim et al. found a negative relation for PDI and a positive one for IDV (Prim et al., 2017). Other authors investigating the role of Hofstede's cultural dimensions on (IT)

adoption and innovation also concluded that a high PDI has a negative (Halkos and Tzeremes, 2013; Thatcher et al., 2003) and a high IDV a positive effect on the degree of innovation (Moonen, 2017; Yaveroglu and Donthu, 2002).

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Also, a positive influence of LTO and IVR have been stated in general as planning and optimism is highlighted as very supportive for innovation projects (Moonen, 2017; Prim et al., 2017).

3 METHODS

Drawing on the initial, quantitative indications, we approached the study of the relationship between dimensions of national culture and DHI in an explorative, qualitative way. We followed this approach with expert interviews, as literature on the influence of culture on digital health innovation processes and on healthcare system's digital health capability is scarce. The aim was to get a diverse picture on European countries, which rank different in the culture dimensions, to investigate the relationship between culture and DHI.

3.1 Study Design

The expert interviews followed a semi-structured interview guide supplemented with additional questions for clarification, examples, and deeper insights. The interview guide included three parts.

The 1st part involved organizational matters, e.g., consent to recording of the interview and questions about the interviewee, such as working experience and current position in the healthcare system.

In the 2nd part, the interviewees were asked about the structure and innovation processes of their country's healthcare system and their understanding of how digital innovation is introduced. Questions related to these two topics were, e.g. "Who are the main actors driving DHIs in your country?", "What strengths of the people/the healthcare system enable DHIs?", or "Do DHI ecosystems exist?".

The 3rd part focused on the central part: cultural influence on the healthcare system. The interviewees were asked about characteristic traits, strengths and trust into the government that may influence the healthcare system and how innovation takes place in that domain. Afterwards, the Hofstede values for each country as well as the individual Culture Compass results served as a basis to investigate how the dimensions may influence the country's health system structure and digital health innovation capability. The country scores of each cultural dimension were categorized as being very low, low, average, high, or very high, compared to the distribution of all Hofstede country scores. Each interviewee was given this categorization and a description of what it means according to Hofstede. Afterwards, they could subjectively assess if they feel this is true for their country and if it has an impact on how the healthcare system is structured or how DHI processes happen.

Also, all experts were asked if best practices from healthcare systems in other countries are only imported from countries that are similar or if the healthcare system's structure of the other country is not relevant for adopting best practices. The aim of that was to analyze if structural or cultural similarity makes it easier to learn from each other.

3.2 Participant Selection

To obtain a diverse picture of European countries, we looked for participants with national backgrounds that scored both minimal and maximal for each of the six cultural dimensions[2]. For each dimension, two countries were selected that are among the five highest or the five lowest scoring countries in this dimension. In selecting, countries with more than one extreme value among the culture dimensions were prioritized. For example, Denmark has one of the lowest scores in PDI, MAS, UAI, and LTO, and one of the highest scores in IVR. Similarly, the scores of Romania are among the highest for PDI and among the lowest for IDV and IVR. Another aspect for country selection was the diversity between geographic parts of Europe. We aimed to include at least two countries per part of Europe.

Interviewees in each country were contacted via two big European networks focusing on DHIs and/or digital health ecosystems as they were expected to be experts for their country's health systems. Those networks are the European Innovation Partnership on Active and Healthy Ageing (EIP on AHA) and the

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[2] Scores available via https://geerthofstede.com/research-and-vsm/dimension-data-matrix/

European Connected Health Alliance (ECHAlliance). In both networks, key stakeholders were contacted via mail to recommend suitable interview partners in each of the selected countries. The goal was to interview two experts per country, which is why the interviewees were also asked to suggest further experts in their country with a position different from their own one. To analyze the answers given by each interviewee in the right context, all participants were given access to the Culture Compass survey with an individual code. The results mirror the background of each interviewee more specifically than the general country scores.

3.3 Interview Conduction

The interviews were conducted in February and March 2021 in the form of online video conferences, which mainly lasted around an hour of time. In total, 23 persons (11 women, 12 men) were interviewed. The goal of two interviews per country was reached in ten countries: Belgium (one interview for the Dutch-speaking Flemish, one for the French-speaking Walloon part), Croatia, Denmark, Estonia, Finland, Germany, Greece, Italy, Portugal and the United Kingdom (one interview for Northern Ireland, one for Scotland). For Norway, Romania, and Slovakia only one expert was willing to participate in our study.

Alongside with the interviews, publicly available data on the healthcare system was used to obtain additional insights. All interviewees, except for one, had at least five years of experience in the healthcare sector. All of the interviewees had a health-related background, seventeen additionally had an IT-related background, and nine of the seventeen had an innovation background on top. Also, the organizational background of all 23 interviewees was quite diverse, ranging from employees of governmental authorities, network organizations or universities to healthcare providers and consultants.

3.4 Interview Analysis

All responses were analyzed across all interviews according to the specific questions. We checked for relationships between the cultural scores and responses, e.g., if the existence of digital health ecosystems or the trust in government are dependent on certain cultural characteristics. Additionally, the perceived influence of each cultural dimension on the innovation structure or capability were analyzed across all interviews to receive an overall statement per dimension.

4 RESULTS

Below, we lay out what impact the Hofstede dimensions had on innovation in the national healthcare system as perceived by the interviewees. Table 3 summarizes whether a relationship was seen and interpreted as being positive or negative. Especially for the PDI and IDV dimension, a beneficial or detrimental influence on DHI of a high or low score might depend on the phase of the innovation, e.g., initiation or implementation. This distinction arises primarily from the main actors in the two phases: while start-ups, companies or researchers are more likely to be the driving force during the creative initiation phase, implementation in the health sector requires governmental authorities (e.g. for a national roll out of DHIs).

Table 3: Correlation perceived by the interviewees regarding Hofstede's dimensions of national culture and DHI capability. Stated positive or negative relationships highlighted in grey for further discussion.

Dimension	Overall	Positive	Negative	Part-part	No correlation	I don't know
PDI	Depends on the step in the innovation process	4	8	4	2	5
IDV	Depends on the step in the innovation process	4	6	2	1	10
MAS	Weak negative	2	6	0	1	14
UAI	**Negative**	**0**	**13**	1	0	9
LTO	Weak positive	7	2	0	3	11
IVR	**Positive**	**13**	**1**	0	1	8

In the following, the results per dimension with the feedback and thoughts of the experts are presented more in detail. We rearranged the order of presentation to: first, discuss MAS as this is the only dimension that correlates directly with DH Index; second, focus on UAI and IVR as these dimensions were commonly assessed influential by the experts; and last, complete the overview of interview results with selected impressions of the remaining dimensions PDI, IDV and LTO.

4.1 Masculinity (MAS)

The dimension MAS was associated with caring, status, position, quality of life, and well-being. To counteract the problem of this dimension being often linked to gender roles (Gaspay et al., 2009), we have only paraphrased this dimension in the interview, but not mentioned it by name. The majority of the interviewees, 14 out of 23, did not know how to interpret MAS in the context of DHI. The interviewees remarked that the healthcare system is generally oriented toward the common welfare in terms of structure and goals, thus inherently feminine and caring for people. Looking at the individual actors in the healthcare domain, e.g., doctors or politicians, a high MAS was considered rather obstructive, especially for the implementation of DHIs, since the pursuit of status of the individual may be in opposition to the idea of the common good.

4.2 Uncertainty Avoidance (UAI)

The dimensions UAI and LTO were difficult to delineate, but we try to focus on each dimension separately. UAI was associated with system structure, regulation, risk taking, predictability, and in the health context strongly with evidence. The interviewees identified an almost exclusive negative relation between UAI and DHI capability. Reasons for that are that a high UAI slows down innovation due to falsely assumed security (GER), and that a "need for stability may disrupt innovation" (SLK) because "in order to accept innovation you need to accept uncertainty" (ITA). Other feedback was also related to the individual context in each country, e.g., that in Denmark, due to a good social security system, risks can be taken, people are not afraid of risks and thus can drive innovation (DEN).

Over all interviews, the experts expressed that UAI itself may hinder innovation as it leads to people not taking risks and not focusing on change. However, they also expressed that security is nice to

have on the personal level. Some healthcare specificities also affect this dimension, as the healthcare sector immanently requires certainty in terms of evidence-based medicine and is strongly structured and highly regulated. By highly regulating it, the healthcare sector tries to give security and stability. However, this should not go too far, as an Estonian interviewee mentioned: "Healthcare is moving to […] a more regulated field […], but on the other hand you can't go too far with the rules because every person is an individual and there are so many variables when you make treatment or diagnostic decisions that you can't describe all rules".

All in all, there seems to be a negative relation between UAI and the DHI capability.

4.3 Indulgence (IVR)

IVR was associated with how optimistic people in each country are and how far they are open for new things/innovations and are not afraid to fail in the area of innovation. This was considered for the initiation and implementation phase alike. The IVR dimension was not very much commented on but more than half of all interviewees (n=13) saw a positive connection between IVR and innovation.

The statements of the interviewees fully support the quantitative results, namely that there is a strong positive relation between IVR and innovation in healthcare, i.e., the higher a country's IVR the higher its degree of innovation in digital healthcare

4.4 Statements on Other Dimensions

4.4.1 Power Distance (PDI)

PDI was particularly associated by the interviewees with hierarchies, communication opportunities and information flows with stakeholders of DHIs, and national or regional governmental regulations in general. Regarding the effect of PDI, eight interviewees indicated that PDI and innovation are negatively correlated as it was associated with few opportunities for entrepreneurs as well as limited participation and communication flows. On the other hand, four interviewees felt that strong hierarchies are helpful for DHIs, as they can drive and support innovation from the top.

Another four interviewees differentiated between the impact of PDI on innovation initiation and innovation implementation. A low PDI was perceived as beneficial in the initiation phase, but for implementation a higher PDI was considered more advantageous. A lower PDI is perceived better for

initiation and creativity regarding DHIs as "[low PDI results in] flat hierarchies that give people the ability to think, you encourage them and that helps [DHI]" (BEL-Flanders) and "you get feedback and support" (DEN). A "[high PDI] makes it harder to innovate, harder to implement a solution because success is affected by your position in the hierarchy" (CRO). This is also reflected by some respondents who indicated that the country's innovation processes are either bottom-up or bottom-up in combination with a top-down approach, but not exclusively top-down.

In terms of DHI implementation, a higher PDI was considered better since it may speed up decision-making and implementation processes due to less discussions, "it is just decided, we will do it this way" (GER). Moreover, in the healthcare domain "no innovations were successful that have not been given blessing by higher level decision-makers" (CRO) implying the need for governmental support.

Additionally, some interviewees concluded that an average value, something in between strong and flat hierarchies, is the worst for DHI initiation and implementation, as it neither fosters innovation through consensus nor enforcement.

Further, we observed that countries with existing or developing DHI ecosystems tend to have a lower or average PDI value which may suggest that the value of networks is more likely to be recognized in countries with a low PDI.

4.4.2 Individuality (IDV)

The dimension IDV was associated with creativity, entrepreneurship, forerunners/leaders, teamwork, collaboration, and group dependency vs. a focus on an individual. As with PDI, in different phases of DHI different IDV traits were considered necessary by the majority of the interviewees. A higher IDV was perceived to be better for initiating DHIs as "innovation needs to be started by strong individuals" (CRO) and a high IDV was linked to innovative forerunners, albeit "[too high IDV] might prevent working in a team and this is crucial for innovation [implementation]" (BEL-Flanders). Hence, a lower IDV was regarded as helpful for implementation, i.e. the rollout of DHIs, because forerunners with ideas will have to work in groups or be supported by groups to reach broader mass, acceptance, and consensus and actually implement DHIs (DEN). The need for groups or network thinking also became clear as many of the interviewees' countries increasingly rely on or have defined the emergence of ecosystems in the healthcare sector as a goal. 17 of the 23 experts reported that they either have several ecosystems

mainly on the regional level or one central one already in place or are currently working on it.

4.4.3 Long-term Orientation (LTO)

The dimension LTO was often associated by the interviewees with legislation (periods), regulation and predictability. Many interviewees expressed the political uncertainty regarding rules as related DH strategies are highly dependent on the governance periods (BEL-Flanders, CRO, EST). This was also expressed as a sector-specific aspect as healthcare is highly influenced by the government, regarding the regulation but in some countries also regarding financing and research funding. Another aspect related to the dependence on legislation periods is political will, which needs to be present to bring DHI forward ("You need political will to make this all happen" (FIN) and "[it is] not a question of regulation but political will" (POR)).

Even though eleven interviewees were uncertain regarding a possible relation, seven saw a positive relation, two a negative one and three saw no relation at all. Reasons for seeing a positive relation were that it would be better for the healthcare sector and DHIs if regulations and agendas would last longer than one legislation period as this would increase the plannability for all stakeholders, which in turn supports the innovation capability. Even though the administration in some countries works on long-term strategies or visions, this is in some countries still subject to change when a new minister comes in (BEL-Flanders). A similar observation was made in Greece: A stronger focus more on the long-term is needed and "we [Greeks] have strategies, but in practice actions are guided by where the money is". In other countries, such as Estonia, "strategies are not changing with the governments". From some experts, a negative relation was seen as in that people may stick to the status quo when LTO is high, which in turn hinders innovation (GER).

Based on the qualitative results, we cannot fully confirm but like to call a tendency towards a positive relation between LTO and the DHI capability.

4.5 System Comparisons

In planning the interview, we expected to see an influence between cultural characteristics and best practices from other countries that are adapted and implemented. Our expectation was that countries rather look into countries with a similar system and, even if not directly intended, with comparable cultural dimension scores to get inspiration or adapt

best practices. However, the qualitative results could not support this view. Only in some countries, the focus is on similar structures but not necessarily on the country-level. In Slovakia, for example, Scotland is taken as an example as they are similar in size of population and structure of the system. Another example is Belgium where Netherland and France are looked at as they both have a Bismarck system and are closely related to Belgium. Also, Switzerland is looked at as it also has different cultures within one country like Belgium. In general, the experts stated that – no matter how similar or diverse a country's structure or healthcare system is compared to others – each best practice from another country needs to be "translated" to the specific national conditions. The focus is on "pick and change" (BEL-Flanders), which is mostly done on a small-scale level (e.g. region or municipality rather than country level) as pointed out, e.g., by experts from Estonia, Germany, United Kingdom and Italy.

5 DISCUSSION

Based on the qualitative results, we have found valuable indications about how Hofstede's dimensions of national culture influence DHI processes and/or DHI capability of societies. We could therefore confirm the importance of cultural factors for the area of DHIs and support the thesis that "an understanding of culture is important to the study of information technologies (IT) in that culture at various levels, including national, […] can influence the successful implementation and use of information technology" (Leidner and Kayworth, 2006). Regarding the main usage scenarios of intercultural awareness stated in the introduction, we provide in the following practical and scientific implications.

5.1 Implications for Research

With our study we contribute to the knowledge base regarding the influence of national culture focused on DHI processes and capability. Our indications lay the groundwork for further studies especially for hypothesis building that can help beneficial investigations for increasing the DHI capability in healthcare systems worldwide.

Our findings do not provide final evidence on whether or how a single dimension of national culture influence DHI processes or capability. Regarding our observations and argumentation above, we'd rather like to highlight MAS, UAI and IVR as dimensions for further research. MAS and UAI are two

dimensions that seem to have a negative influence on the degree of innovation in general and also in the digital health area. IVR was seen as having a positive influence not only on innovations in general but also on the innovation capability in digital healthcare, i.e., the more optimistic the people in a country and healthcare system, the easier new innovations are initiated and implemented. In contrast to our approach, further investigations should more focus these dimensions to foster evidence on their influence and interdependencies. We therefore recommend to precise hypotheses or research questions by content but extent the number of participants or interviewees for a proof our indications.

Based on further large-scale studies including other countries worldwide, best practices could be identified between certain countries belonging to one cultural cluster as it has been done by Braithwaite et al. for the performance of health systems (Braithwaite et al., 2020). Our study only laid the groundwork into this direction by identifying correlations, which are partially different for certain phases in the innovation process. A deeper analysis of the various phases of the DHI process could reveal finer granular results. Based on this, precise recommendations could be derived in how far each of the phases can be supported best depending on in which country the innovation takes place.

Another finding of our study was that best practices from other countries are rather found and implemented on a regional, not on a national level. This is also underlined by initiatives such as EIP on AHA, where certain regions across Europe are connected to share their experiences and knowledge. The structures of national healthcare systems may be too diverse on a national but more similar on a regional level. This could also be further investigated in future studies if there are sub-cultures within several countries which are more similar at this regional than on the national level and can therefore be considered when getting new impulses for improving the healthcare system and its innovation capability regarding digital health.

5.2 Implications for Practice

When starting the study, our hypothesis was that DHI ecosystems can support the successful long-term implementation of digital health innovations and thus a society's DHI capability but that the existence of such ecosystems is dependent – among others – on cultural aspects. With our study, we could generally confirm our assumption and found indications for a detailed and differentiated view on those cultural

aspects. Our investigation highlights thereby Hofstede's dimensions MAS, UAI and IVR but does not reject the other dimensions. Rather, we argue that MAS, UAI and IVR might be a suitable starting point for increasing cultural awareness activities and discussions. In harmony to our motivation, we would like to promote the use of our indications in practice for: I) Analysis of multi- or international usage contexts of upcoming DHI projects to adjust requirements of DHI artefacts or innovation process models; II) Management purposes of international collaboration for DHI projects to improve internal project organization; III) Interpretation and adaption of "best practice" and "lesson learned" description or case study research; and IV) Design and conduction of international DHI initiatives and programs that seek to support DHI knowledge exchange or to build international data or innovation spaces.

While technological progress will continue dynamically, established structures of health systems (e.g., its segmentation, regulation and administration) are rough to change simultaneously due to their linkage to national culture. International intended DHI projects or programs should not underestimate the task of bridging such gaps. In Slovakia, for example, the innovation-driving health insurance company is private, which leads to implemented DHI but also lacks in accessibility to society (only for ensured people). A similar case could be found in Germany, where pilots are financed by various health insurance agencies and only people insured by the respective agency are then able to use them. In Croatia, old-fashioned laws affecting DHIs can be interpreted flexible, which supports DHIs, while the peer pressure from other countries further boosts the initiation and implementation of DHIs. The system in the United Kingdom, in turn, supports DHIs by its segmentation. As a national health system exists for each member state, networking is easy as each system is autonomous and relatively small, so that the actors involved know each other what enables collaboration.

Differences in the presented dimensions of national culture may have led to structural country-specific aspects that were also noted by the interviewees. For example, the Greek interviewees also highlighted financing is a crucial element. Greece relies heavily on EU funding and may hence have less "in-house" structures to support DHIs than other countries. Also, dimensions of national culture may be influenced the development of digital infrastructures (EST), the level of education and innovation mentality (NOR) or principles of equity and equality (FIN) that do now positively influence ongoing and upcoming DHI progress. On the contrary, the Romanian interviewee expressed a general mentality to settle with things and to lower consequently the desire to pursue the new which can also hinder innovations in general. Additionally, one German expert expressed that Germans trust in regulations and are only seldomly pragmatic, which can negatively influence the speed of innovations. Those longitudinal dependencies of cultural aspects leading to structures and phenomena and again leading to positive or negative DHI influence factors are scientifically investigated as "path dependencies" (Arthur, 2021) and should also be more considered in practice-oriented discussions of international DHI projects or programs.

Two additional thoughts mentioned by a Belgium and a Romanian expert should complete this practical implication section. First, the case of Belgium showed that culture and (innovation processes in) the healthcare system can differ vastly even within one country. Even though the Flemish and the Walloon system together with Brussels form Belgium, there are different cultures and (healthcare) systems in place in each region. Thus, our implications regarding "international cultural awareness" could also be valuable for intranational DHI projects or programs under specific circumstances.

Second, the Romanian interviewee expressed that culture does not seem to play a major role for the innovation capability in the healthcare system of Romania. Rather, missing leaders and money are the most important problems that need to be solved to focus more strongly on DHIs. "Even if you had all this mentality and all these other aspects [positively influencing cultural factors], if you don't have the money to buy an aspirin, [...] you can dream a lot but it is pretty much impossible to do the innovation." Thus, our presented implications might be very helpful but should be reflected with the inclusion of other, directly noticeable issues.

5.3 Limitations

Our study is limited in three areas, the usage of Hofstede's dimensions of national culture, the conducted qualitative analyses and the influence further cultural perspectives beyond nationalities.

The six cultural dimensions of Hofstede are not the only concept that can be used for describing cultures on a national level and are also subject of criticism and discussion (Gaspay et al., 2008). Other dimensions are, e.g., monochronism vs. poly-chronism (Hall, 1976) or locus of control (Smith et al., 1995). The former describes if there is a focus rather on performing one or several activities in

parallel and the latter if one's own life is seen as being controlled external or internally (Leidner and Kayworth, 2006). However, Hofstede's dimensions are often used and can easily be applied to one's own research as the country scores and the Culture Compass are publicly available. As these dimensions are widely used, they also enable a comparison among studies conducted by different researchers.

Also, the qualitative study contains some limitations. Although we had a number of interviewees with different professional as well as cultural backgrounds, the statements collected remain a sample of experiences that may not be representative in a certain country. We aimed to take personal bias and the character traits of our interviewees into account by applying the Culture Compass and involving two persons per country, but a differentiation between an individual experience and group opinion/national culture remains difficult. Also, our study focused exclusively on European countries and is therefore limited to these countries. Further large-scale studies are needed in future work to confirm the results also for other countries.

Our study focuses on differences between national cultures. However, "cultural" factors influencing the success of DHI processes and the DHI capability of societies can also be stated from other perspectives. Broaden the realm of cultural influences, we see that the need of interdisciplinarity and interorganizational collaboration in initiating, conducting, and implementing digital health artifacts cause further cultural influence factors. Thus, other concepts next to the Dimensions of National Culture (DNC) used in this paper should be added to ensure a comprehensive understanding of intercultural awareness. With the Dimensions of Organizational Culture (DOC), Hofstede also offers an organizational view and describes similarities and differences between organizations by their values, rituals, heroes, symbols and practices (Hofstede Insights, 2020). Interdisciplinarity or interprofessional collaboration might be addressed by the concept of Institutional Logics (IL) that can be used to describe the pluralism of values, logics and behavior from medical, business, legal or technological standpoints (Berente et al., 2019; Hansen and Baroody, 2020; Thornton et al., 2012). We therefor want to motivate both research and practice of DHI to use our indications of international cultural influence factors under consideration of these overlaying concepts. Figure 1 illustrates the interconnection of cultural perspectives by nations (DNC), organizations (DOC) as well as disciplines (IL) and highlights the "heart" of international

cultural awareness in relation to other cultural influences. We suggest, that discussions about culture-related phenomena in the digital health domain should seek to clarify the spot within this heart for each phenomenon as influences of DNC, DOC and IL may occur simultaneously and interdependently, but rarely equilibrated.
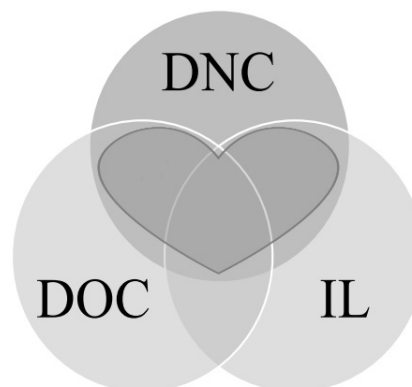

Figure 1: Overlaying concepts for intercultural awareness.

6 CONCLUSION

In our expert study, we discussed the influence of Hofstede's dimensions of national culture on DHI and a DHI capability. Our findings provide indications on how practice and research should be aware of each dimension to promote DHI processes or DHI capability. Due to our findings, *Uncertainty Avoidance* seems to influence DHI projects negatively while *Indulgence* have been interpreted as a positive influence factor. *Power Distance* and *Individualism* might influence DHI differently depending on the development stage of a DHI. *Long-term Orientation* was assessed as generally supportive while rapidly changing circumstances challenge this characteristic. Even though *Masculinity* correlates negatively with the DH Index of a previous Bertelsmann study, our findings could not clarify this numeric indication conclusively. International collaborations or DHI for multinational usage contexts should primarily benefit of our contribution under consideration its limitations.

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