RESEARCH ARTICLE

# Sociocultural factors and academic openness of world countries

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## ABSTRACT

Academic openness (i.e., the extent of collaborative academic activities of nations with external actors in the science communication system) has been regarded as a major contributor to strong science. We used several nation-level data sets to explore the associations of sociocultural factors with the academic openness of world nations. To check the robustness of relationships, two distinct data sets for academic openness of nations were used in this research. Our findings showed the strong relationships of some dimensions of national culture and (economic and human) resources with both academic openness indicators. The findings were discussed considering Schwartz's national culture theory, and the implications were presented in conclusion.

## 1. INTRODUCTION

The aim of this paper is to make a survey of how several sociocultural factors correlate to academic openness of nations, and to analyze what factors possibly contribute to—and hinder—academic openness. Further, we aim to look at the possible connection between certain national culture dimensions and the degree of academic openness in a country, mainly based on Schwartz's categorization of national cultures (Schwartz, 2006, 2008).

The question of openness and collaboration has long been a relevant one within research and science, even though the discourse has developed. Michael Polyani, in his canonical article originally published in 1962, describes science as a community, a "republic," where the individual researcher, in taking others' work into account and building on it, is part of a larger community. In a striking image, he compares this to a group of people collaborating to put together a large puzzle, where it is imperative to be aware of what pieces everyone else involved has: "The only way the assistants can effectively cooperate and surpass by far what any single one of them could do, is to let them work on putting the puzzle together in sight of the others, so that every time a piece of it is fitted in by one helper, all the others will immediately watch out for the next step that becomes possible in consequence" (Polyani, 2000, pp. 2–3). He sums this up as a "self-coordination of independent initiatives" (Polyani, 2000, p. 3). Were these initiatives to be steered by a superior authority, they would, as a consequence, stop progressing (Polyani, 2000, p. 3).

The concept of *academic openness* has been a topic of conversation and advocacy among numerous scholars, institutions, and organizations in education, research, and publishing. It is

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not defined universally with a single accepted meaning; instead, it covers a spectrum of principles and actions connected to transparency, accessibility, collaboration, and the dissemination of knowledge. Maso (1995) discussed three dimensions of *openness in research* that a (qualitative) researcher must be aware of: being receptive to the research context (e.g., willingness to opening research questions for others' examinations/revisions); openness in the research process (being eager to collaborate with others in research); and perspectives as a researcher (self) (pp. 7–20). This willingness to include *others* in research has been used by Olmos Peñuela, Benneworth, and Castro Martínez (2014, p. 4) to formulate academic openness as the external influences and stimuli that researchers allow to enter into their own work.

Openness can thus include cross-cultural and other types of collaboration, but it can also include a variety of other factors, including personal experiences, attitudes, ideas, and identities—not only related to one's working life and persona, but to all parts of one's life, past and present. As we analyze the cultural factors behind these characteristics, it raises the question of how much this pursuit is a choice made by the individual researcher, and to what extent external factors influence their options. What possibilities a researcher must pursue for different kinds of openness is difficult to measure, and will be discussed towards the end of this paper.

Although academic openness could be regarded as a positive trait in research, there are both critical and enthusiastic voices in this debate (Hollis, 2001; Hudson, 1996; Olmos Peñuela et al., 2014). One of our motivations for exploring this subject is also the belief that academic openness is essentially a positive thing, yet it can also have unfavorable aspects to it, as will be touched upon in the discussion.

Academic openness in our research is defined as *the extent of willingness of individuals, institutions, and nations to do academic activities with external actors in the science communication system*. Academic openness could be quantified and analyzed on three levels: the micro (individual) level (that is, the willingness of a researcher to work with other external researchers, e.g., via coauthorships); the meso (institution) level (that is, the degree of connectivity/collaboration of higher education institutions with other institutions or the business sector); and the macro (nation) level (e.g., the share of coauthored publications of a nation with other nations, the research mobility of a nation, and the share of international students/researchers in a country). Our focus in this study is mainly on the macrolevel analysis of academic openness, yet these three levels are, of course, intertwined.

### 1.1. Academic Openness and Academic Freedom

Academic openness, perhaps in particular the part of it involving cross-national research cooperation, has major implications, and it will not be possible within our scope to consider all aspects. Besides, cultural aspects will never have identical meaning, impact, and consequences for all individuals within the same culture. Moreover, it is possible to assert that on a general basis, openness as a phenomenon affects individuals in a myriad of ways, even though the precise effect cannot easily be measured.

A related, but not directly overlapping, term in relation to academic openness, is academic *freedom*. Tierney and Lanford (2014, p. 5) argue that academic freedom has more facets than are sometimes taken into account, and forms a more complex picture than before, as commercialism has entered academia. In other words, it is not only formal hindrances to academic freedom (for example, when a researcher is limited by their country's government), but also to a large degree limitations set by what kind of research is funded, encouraged, and can be

performed and distributed without fear of negative consequences. In short, one can say that without at least some degree of freedom, openness can hardly take place. Nevertheless, although these and other discussions concerning academic freedom are certainly both relevant and highly interesting in relation to our study, academic freedom is such a large and complex field that an extended discussion of these matters falls outside the scope of our study. For a discussion of some of these matters, see Whetsell, Dimand et al. (2021), who analyzed the impact of nations' levels of democracy on science.

### 1.2. Sociocultural Factors and Academic Openness

Science is a part of culture, and accordingly, the activities of scholars are influenced by surrounding cultural contexts (Bartling & Friesike, 2014, p. 8; Iaccarino, 2003). It is obvious that the success of open science movements requires technological infrastructures, but the policies or the eagerness of policymakers are the driving forces of those movements (Gerber, 2014, p. 78).

Previous research (e.g., Khosrowjerdi, Sundqvist, & Byström, 2020) has revealed the important role of national culture in describing similarities and differences in the way nations use information sources, but research on the sociocultural factors influencing the academic openness of nations (as an aggregate indicator in our study) is limited. However, we mention here those parts of the literature that could be partially relevant to our research. For this purpose, we included those studies that were focused on factors influencing (various types of) openness/collaboration of nations (economic, academic, etc.). Furthermore, because international academic collaborations (e.g., coauthorships) are a major building block of academic openness in our research, we included research evidence that was focused on cross-country or geographical analysis of academic collaborations, coauthorships, and scientific performance.

Mattessich and Monsey (1992) carried out a systematic review of factors influencing the success of collaborations. They categorized those factors into six groups:

- Environment (e.g., the national/political context in which the collaboration happens and the perceptions of members of society regarding collaboration);
- Membership (e.g., the cultural values/norms of collaborators, mutual respect and trust);
- Process/structure (e.g., the nonhierarchical participation of group members in decision-making processes);
- Communications (free flows of communication/discussions);
- Purpose (e.g., common goals and having a sense of commitment);, and
- Resources (economic resources and expertise).

Acosta, Coronado et al. (2011) investigated the factors that impact interregional academic scientific collaboration in Europe. They focused on socioeconomic distances (i.e., the differences in economic, social, and cultural factors between regions) and how those distances form collaborative links among researchers. The authors revealed that socioeconomic distances can hinder collaboration, as researchers were less willing to collaborate across regions that had different economic and cultural backgrounds.

Taylor (2016) argued that innovation is not solely driven by scientific and technological advancements, but also by political and economic factors. The researcher examined case studies of different countries, such as the United States, Japan, and China, to show the influences of political and economic systems on the innovation abilities of nations. Taylor's analysis showed that countries with democratic political systems tend to have more open and diverse

innovation environments that offer better opportunities for collaboration and funding. In contrast, centralized political systems, such as China, may have more focused and directed innovation efforts but may encounter difficulties in promoting diversity and openness.

Wagner and Jonkers' (2017) study suggests that countries with strong scientific output are those that are more open and connected to the global network. By analyzing research collaboration and the international mobility of researchers, the authors revealed that countries with higher levels of openness and collaboration tend to produce more impactful scientific research. The study underscores the importance of cultural factors in scientific research and highlights the need for promoting open and collaborative research environments to foster scientific innovation.

Yamaguchi, Fujimoto et al. (2018) investigated factors that could influence industry–academia collaboration activities in private universities in Japan. The study revealed that universities with higher levels of trust among faculty members and managers, and those with better communication channels, were more likely to have successful collaborations with industry partners too. This research emphasizes the significance of cultural factors such as trust and communication in promoting collaboration.

Khosrowjerdi and Bornmann (2021) investigated the role of cultural values on scientific performance of world nations. They correlated two nation-level data sets on national culture (Hofstede and Inglehart-Welzel) with two citation impact indicators, and controlled for the possible effects of national self-citations, international coauthorships, investments in research and development, international migrant stock, number of researchers of each nation, language, and number of publications. The authors revealed that cultural factors may play a significant role in shaping scientific output (such as in the form of citation impact). They showed that open and free societies (characterized by the freedom of expression and active participation in social and political decision-making) were more likely to produce strong science.

There is evidence that national culture values correlate with the economic openness of nations (operationalized as the unlimited merging of national trade with the world market) (de Jong, Smeets, & Smits, 2006), and academic openness (i.e., the collaborations of researchers of a nation with international researchers) empowers the science system of nations (Wagner & Jonkers, 2017). As de Jong et al. (2006, p. 114) stated, "In general, the argument is that open economies are able to capture knowledge externalities from foreign firms which in turn will spur economic growth."

Nevertheless, there is little known about the possible interactions of sociocultural variables and the academic openness of nations, and large, cross-country comparisons are rare. This research contributes to filling this gap, focuses on the sociocultural factors, and investigates the role of those factors in the academic openness of nations. In this research, we posit the following research questions:

- How do sociocultural factors predict the academic openness of nations (if any)?
- Which cultural factors have stronger ties with academic openness (if any)?

We include those factors/variables (i.e., culture, human resources, economic resources) that have been mentioned in the literature as possible correlators with academic openness. These themes, with all their constituent and adjacent fields, are of course, a large subject area, so we by no means aim to do a complete survey. There are also many curtailing and modifying factors, which will be addressed towards the end of this paper.

## 2. THEORETICAL FRAMEWORK

### 2.1. Definitions of Culture

The term "culture" is widely used, but often without a specific explanation of which of the many meanings of the term one is making use of. Klausen (2018) shows how the word "culture" is often used liberally, as if its meaning was obvious, when, in fact, it is anything but (he refers mainly to a Norwegian context, but his points are transferable). There are, as Klausen (2018, p. 72) sums up, two main categories into which the definitions of culture fall: One is simply an overarching term for all kinds of art, but the other is more complex, described as

> [...] the acquired ideas, values, norms, symbolic expressions and behavior of a group of people. This is culture in the meaning of distinctive characteristics of a group (In later public debate, this is often referred to as the anthropological concept of culture) (Klausen, 2018, p. 72 [our translation]).

Klausen (2018, p. 72) goes on to point out that the two categories certainly may overlap, but nevertheless "the two concepts are different." A further category is mentioned by Jordheim, Rønning et al. (2011), who also include a definition of "culture" as that which is not "nature," but historically contingent (pp. 105–106). The concepts of culture they include are "The oldest is related to the study of a certain people's spirit, manifested in concrete, aesthetic objects; the next is related to the study of the underlying structures of practical everyday life; the last is related to the study of the changeable in our ways of understanding and concepts of reality" (Jordheim et al., 2011, p. 106 [our translation]).

Our definition of culture in this paper will be clarified further when we present Schwartz's theory, but initially we can stipulate that our main use of the concept "culture" in this study falls within the second category, namely that of (in Klausen's terms) the "distinctive character of a group" (Klausen, 2018, p. 72), as well as a historical awareness corresponding to the third category of Jordheim et al. (2011, p. 106), although, as Klausen points out, art can certainly both express and be part of anthropological culture (Klausen, 2018, p. 72). The same is true for much humanities research, one can argue, which often takes art and its different (cultural) contexts as its object of study.

### 2.2. Schwartz's Theory of Culture

Several researchers have empirically mapped and compared the cultural values of nations (Hofstede, 2001; Inglehart & Baker, 2000; Inglehart & Welzel, 2005). In this research, we use Schwartz's cultural theory (Schwartz, 2006) and the associated data (Schwartz, 2008) because of its availability (we could access the mean scores of nations on proposed values); inclusivity (the data were available for 80 countries); representativeness (the data were based on representative matched samples); validity (later researchers could replicate Schwartz's value dimensions based on recent data); favorableness (Schwartz' cultural theory has received less criticism by later researchers); and popularity. Researchers in various disciplines have applied Schwartz's cultural values in their empirical research. Those studies are from fields such as social science (e.g., Urzúa, Miranda-Castillo et al., 2013), education sciences (e.g., Benoliel & Berkovich, 2018), economy, innovation, and management (e.g., Hyde & Ong, 2020; Soloviov, 2022), health sciences (e.g., Heim, Wegmann, & Maercker, 2017; Tekeş, Üzümcüoğlu et al., 2019), and information systems (Guo, Warkentin et al., 2020). However, the decision to use Schwartz's cultural theory was the result of a longer process of considerations, where we initially gave thought to other cultural models. From previous experience

with the noted models of Hofstede and Inglehart (e.g., Khosrowjerdi & Bornmann, 2021; Khosrowjerdi et al., 2020), Schwartz emerged as the most appropriate choice for this particular project. Moreover, as will be elaborated in the discussions, the whole idea of the quantification of cultural phenomena has its limitations and implications. Cultural values will always be too complex to be exhaustively described by any single method, and further, a mainly quantitative approach will necessarily omit important, less quantifiable aspects.

According to Schwartz (2012), the (cultural) values of all nations are more or less the same, but the importance that the different values have for each nation varies. Schwartz stated that values reflect what is important to us, and that values were linked to affect (Schwartz, 2012, p. 3). This again means that what is important to us creates enthusiasm and motivation, which again leads to action (Schwartz, 2012, p. 3). Similar kinds of questions have been raised within certain strands of affect theory, a highly diverse and interdisciplinary field which explores how affect informs and influences complex connections on different levels of human lives and interactions (for an overview, see for example Figlerowicz, 2012).

Because values pertain to affects, which in turn can influence behavior, it is evident that values have a link to academic openness as a behavior. What are taken as central values in a given group or community are in step with what action is taken. This is also valid for pedagogy: What a teacher or a researcher stresses reflects what they consider important within the context.

Schwartz (2006, p. 140) believed that "cultural value orientations evolve as societies confront basic issues or problems in regulating human activity" and analyzed the responding mechanisms of societies to those issues or problems to find those value dimensions that could distinguish one culture from another. Schwartz (2006, p. 140) identified three societal problems that all societies must face: the essence of individual–group relationships (named *embeddedness versus autonomy*); ensuring the responsive behavior of individuals of a nation to maintain social structure (named *hierarchy versus egalitarianism*); and regulating the relationships of people with the environment and society (named *mastery versus harmony*). Schwartz (2006, pp. 140–141) stated that those three value dimensions of culture were represented by seven value orientations, described in Table 1.

**Table 1.** The value dimensions of culture (Schwartz, 2006, pp. 140–141)

| *Value dimension* | *Description* |
|---|---|
| Harmony | The compatibility of individuals of a society with nature, environment, and the world. The harmony cultures emphasize values such as peace and protecting the environment and natural resources. |
| Mastery | Mastering or changing nature and the environment to reach individual or collective outcomes. Values such as aspiration, favorable results, courage, and capability are common in mastery culture. |
| Embeddedness | The strong group attachments of individuals of a society. Embedded cultures were characterized by values such as social order, traditionalism, safety, subordination, and wisdom. |
| Hierarchy | The acceptance of inequality of power distribution in a society. In hierarchy cultures, values such as social power, authority, humility, and wealth were most common. |
| Egalitarianism | The importance of the wellbeing of all individuals of a society. Equality, social justice, responsibility, help, and honesty were listed as common values in egalitarian cultures. |
| Affective autonomy | The opportunity of individuals of a society to pursue affectively positive experience for themselves. Values such as pleasure, exciting life, and varied life were listed as important in affective autonomy cultures. |
| Intellectual autonomy | The freedom of individuals of a society in pursuing their ideas. The intellectual autonomy cultures were characterized by values such as broadmindedness, curiosity, and creativity. |

Schwartz (1999) measured and validated those seven value types based on more than 35,000 respondents from 122 samples in 49 nations. They gathered data from two groups—urban schoolteachers and college students. Schwartz (1999, p. 34) believed that urban schoolteachers could be a proper matched group in cross-cultural studies and argued:

> As a group, they [urban schoolteachers] play an explicit role in value socialisation, they are presumably key carriers of culture, and they probably reflect the midrange of prevailing value priorities in most societies. (Schwartz, 1999, p. 34)

Schwartz (1999) recognized that collecting data from various representative samples of nations could lead to different mean scores of values, but he assumed that the resulting position and order of nations would be relatively consistent. He used data from a group of college students to test the findings from a group of urban schoolteachers and found that the seven value types were positioned similarly relative to each other in both samples.

## 3. METHODOLOGY

In this research, we apply a secondary data analysis approach: that is, using previously gathered data sets (or research data) to target a new research problem/question (Vartanian, 2010, p. 3). We use several nation-level data sets to explore the possible relationships between sociocultural factors (i.e., national culture dimensions, economic and human resources) and the academic openness of nations.

Descriptions of all the included data sets are provided in Table 2. We have regarded academic openness as our dependent variable in this study, and we will investigate the associations of several sociocultural factors with this variable. To investigate the robustness of the results, we have included two different data sets (for different time intervals) for our dependent variable.

### 3.1. Data

#### *3.1.1. Academic openness*

Academic openness is represented in this study by two indicators: an openness index (Wagner, 2018; Wagner, Whetsell et al., 2018) and a connectivity indicator (Williams & Leahy, 2020). Wagner et al. (2018) calculated the openness index based on the fractional number of national publications, share of internationally coauthored publications, and mobility of scholars of world countries. The connectivity indicator developed by Williams and Leahy (2020) included the proportions of international students in tertiary education, the ratio of internationally coauthored publications of a nation, the number of links to university websites of a nation (divided by population), the development rate of knowledge transfer between the universities and companies of a nation, and the percentage of coauthored publications of university researchers with industry researchers.

#### *3.1.2. National culture*

For the cultural data, we included Schwartz's data on the cultural dimensions of nations which were available for 2008 (Schwartz, 2008). The data included mean scores of nations for seven cultural value dimensions: harmony, embeddedness, hierarchy, mastery, affective autonomy, intellectual autonomy, and egalitarianism. The data were available for 80 nations. Although there is no agreement on the stability or dynamics of cultural values, in our research, following the approach of Hofstede (2001, p. 34), we assume that cultural values do not change in the

**Table 2.** Description of the data sets used in this study

| Variable(s) | | Description | Source | Applied year (in analyses) |
|---|---|---|---|---|
| **Culture** | Schwartz's cultural values | The nation-level data for seven cultural value dimensions (harmony, embeddedness, hierarchy, mastery, affective autonomy, intellectual autonomy, and egalitarianism) | Schwartz (2008) | 2008 |
| **Academic openness** | Connectivity indicator | An indicator which was composed of five variables: proportion of international students in tertiary education; share of internationally coauthored articles; visibility of/links to websites of universities of nations; knowledge transfer development between universities and companies of a nation; and the percentage of university scientific publications that were coauthored with industry researchers | Williams and Leahy (2020) | 2020 |
| | Openness index | The nation-level scores of openness, which were calculated based on the data on mobility of scholars (the percentage of mobile researchers of nations, which included new inflows, returnees, and outflows) and the percentage of international coauthored articles based upon fractional counting of Scopus data for year 2013 | Wagner (2018) | 2013 |
| **Resources** | Researchers per million inhabitants | Number of full-time equivalent (FTE) researchers of a nation per million inhabitants | UNESCO (2013) | 2013 |
| | Gross domestic spending on research and development (GERD) | Percentage of gross domestic product (GDP) allocated to research and development | UNESCO (2013) | 2013 |
| | GERD per researcher | Proportions of allocated GERD per researcher, full time equivalent (in '000 current PPP$) | UNESCO (2013) | 2013 |
| | Participation in higher education | Enrolment ratio in tertiary education (%) | UNESCO (2013) | 2013 |
| | Total R&D personnel | Total R&D personnel per million inhabitants (FTE) in each nation | UNESCO (2013) | 2013 |
| | Researcher ratio of R&D | Researchers as a percentage of total R&D personnel (FTE) | UNESCO (2013) | 2013 |
| | Academic publishing | Number of publications of nations (fractional) (per million inhabitants) | Wagner (2018) | 2013 |
| | Access to higher education | Number of universities of nations (per million inhabitants) | Spanish National Research Council (CSIC) Cybermetrics Lab (2020) | 2020 |

short term. Recent studies (for example, Zhao, Kwon, & Yang, 2016) show that substantial cultural change would happen over a 20–40-year period.

#### 3.1.3. Resources

The included data for (human and economic) resources in this study and their original sources are listed in Table 2. This includes the data for researchers per million inhabitants, gross domestic spending on research and development (GERD), GERD per researcher, participation in higher education (enrolment ratio in tertiary education), total R&D personnel, researcher ratio of R&D personnel, academic publishing (number of publications), and access to higher education (number of universities).

Because the data for one indicator of academic openness (i.e., the openness index) was based on 2013, the data for other possible confounding variables were selected for the same year (except the data for the total number of universities). The data on the number of universities of a nation for 2013 were either limited or not available, and we used the current data for the year 2020, which were published by the Spanish National Research Council (CSIC) Cybermetrics Lab (2020).

Aligning all the variables' data (listwise), resulted in 27 nations that were included in our later analyses. Descriptions of the data included in this study are presented in Table 2.

## 4. RESULTS

To explore the possible connections of included sociocultural variables and the academic openness indicators in this study, we calculated Spearman's correlation coefficients. The included variables in the later analyses are on an interval or ratio level of measurement, and the data had one outlier. The outlier was the (very large) number of universities of nations (per million inhabitants) for Slovenia. The Spearman's correlation is less sensitive to outliers because the computed correlation coefficients are based on the ranks of the data rather than the actual values. In addition, it does not assume that the data follows a specific (such as normal) distribution.

As shown in Table 3, of Schwartz's seven cultural dimensions, embeddedness and hierarchy had (statistically significant) negative correlations, and affective autonomy, intellectual autonomy, and egalitarianism had (statistically significant) positive correlations with both academic openness indicators (i.e., connectivity and openness index). The cultural dimensions of harmony and mastery were not (statistically significant) correlators with the academic openness indicators.

Of the resource-related factors included in this study, the total number of researchers per million inhabitants and publications per million inhabitants showed (statistically significant) positive correlations with both indicators of academic openness. The gross domestic spending on research and development (GERD) and the total R&D personnel per million inhabitants showed (statistically significant) positive correlations with just one academic openness indicator (i.e., the connectivity of nations). The other three resource-related variables—GERD per researcher, the enrolment ratio in tertiary education, and the researchers as a percentage of total R&D personnel—had no (statistically significant) correlations with the academic openness indicators in this study.

Of all the included sociocultural factors in this study, two dimensions of national culture—embeddedness and affective autonomy—had relatively the strongest (statistically significant) correlations with both academic openness indicators. We further calculated partial

**Table 3.** Spearman's correlation coefficients of national culture dimensions and the academic openness of countries ($N$ = 27)

| | | Connectivity of nations | Openness index |
|---|---|---|---|
| Harmony | Correlation coefficient | 0.06 | 0.14 |
| | Sig. (2-tailed) | 0.78 | 0.48 |
| **Embeddedness** | Correlation coefficient | **−0.80**** | **−0.64**** |
| | Sig. (2-tailed) | 0.00 | 0.00 |
| **Hierarchy** | Correlation coefficient | **−0.52**** | **−0.45*** |
| | Sig. (2-tailed) | 0.01 | 0.02 |
| Mastery | Correlation coefficient | −0.16 | −0.06 |
| | Sig. (2-tailed) | 0.44 | 0.75 |
| **Affective autonomy** | Correlation coefficient | **0.84**** | **0.69**** |
| | Sig. (2-tailed) | 0.00 | 0.00 |
| **Intellectual autonomy** | Correlation coefficient | **0.58**** | **0.39*** |
| | Sig. (2-tailed) | 0.00 | 0.04 |
| **Egalitarianism** | Correlation coefficient | **0.44*** | **0.51**** |
| | Sig. (2-tailed) | 0.02 | 0.01 |
| **Researchers per million inhabitants (FTE)** | Correlation coefficient | **0.70**** | **0.39*** |
| | Sig. (2-tailed) | 0.00 | 0.05 |
| **GERD (as a percentage of GDP)** | Correlation coefficient | **0.53**** | 0.16 |
| | Sig. (2-tailed) | 0.00 | 0.44 |
| GERD per researcher, FTE (in '000 current PPP$) | Correlation coefficient | 0.13 | 0.08 |
| | Sig. (2-tailed) | 0.52 | 0.71 |
| Enrollment ratio in tertiary education (%) | Correlation coefficient | 0.13 | −0.08 |
| | Sig. (2-tailed) | 0.53 | 0.70 |
| **Total R&D personnel per million inhabitants (FTE)** | Correlation coefficient | **0.70**** | 0.38 |
| | Sig. (2-tailed) | 0.00 | 0.05 |
| Researchers as a percentage of total R&D personnel (FTE) | Correlation coefficient | 0.21 | 0.15 |
| | Sig. (2-tailed) | 0.29 | 0.45 |
| **Publications per million inhabitants** | Correlation coefficient | **0.82**** | **0.54**** |
| | Sig. (2-tailed) | 0.00 | 0.00 |
| Universities per million inhabitants | Correlation coefficient | 0.21 | 0.33 |
| | Sig. (2-tailed) | 0.29 | 0.09 |

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Spearman's correlation coefficients to see if the association of national culture dimensions with academic openness factors would be stable after controlling for the effects of those variables (i.e., the total number of researchers per million inhabitants, the total R&D personnel per million inhabitants, total number of publications per million inhabitants, and GERD as a percentage of GDP) which had statistically significant correlations with academic openness indicators in this study (those variables are called confounding variables or confounders).

The partial Spearman's correlation coefficients of national culture dimensions and the academic openness of world countries (after controlling for the effects of four previously mentioned confounding factors) are shown in Table 4. After controlling for the effects of

**Table 4.** The partial Spearman's correlation coefficients of national culture dimensions and the academic openness of countries ($N = 27$)

| | | Connectivity of nations | Openness index |
|---|---|---|---|
| Harmony | Correlation | 0.03 | 0.06 |
| | Significance (2-tailed) | 0.90 | 0.79 |
| | df | 21 | 21 |
| **Embeddedness** | Correlation | **−0.64**** | **−0.49*** |
| | Significance (2-tailed) | 0.00 | 0.02 |
| | df | 21 | 21 |
| Hierarchy | Correlation | −0.22 | −0.37 |
| | Significance (2-tailed) | 0.33 | 0.08 |
| | df | 21 | 21 |
| Mastery | Correlation | −0.01 | −0.03 |
| | Significance (2-tailed) | 0.95 | 0.90 |
| | df | 21 | 21 |
| **Affective autonomy** | Correlation | **0.65**** | **0.49*** |
| | Significance (2-tailed) | 0.00 | 0.02 |
| | df | 21 | 21 |
| Intellectual autonomy | Correlation | 0.26 | 0.20 |
| | Significance (2-tailed) | 0.24 | 0.36 |
| | df | 21 | 21 |
| Egalitarianism | Correlation | 0.24 | 0.35 |
| | Significance (2-tailed) | 0.26 | 0.11 |
| | df | 21 | 21 |

Note: *Confounders*: the total number of researchers per million inhabitants, the total R&D personnel per million inhabitants, total number of publications per million inhabitants, and GERD as a percentage of GDP.

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

confounding variables of Schwartz's seven cultural dimensions, two dimensions showed statistically significant correlations with academic openness indicators as follows. Embeddedness and affective autonomy remained statistically significant correlators of both academic openness indicators. The statistically significantly correlations of hierarchy, intellectual autonomy, and egalitarianism with both academic openness indicators disappeared.

Furthermore, we visually inspected the data via scatterplots to see if the cultural dimensions of embeddedness and affective autonomy were linearly related to academic openness indicators.

Figure 1 depicts the linear relationships of the embeddedness dimension (of nation culture) and the connectivity indicator. It can be see that there is a sharp, negative, and linear correlation between the noted variables. Those embedded nations (e.g., Turkey, Russia, Poland, China, Brazil, and South Korea) have relatively low scores on (academic) connectivity and they are placed in the bottom-right corner of Figure 1. Similarly, those nations with the lowest scores on embeddedness (e.g., Austria, Denmark, Sweden, and the Netherlands) are positioned in the top-left corner of Figure 1 and have the highest scores on the connectivity indicator.

Figure 2 illustrates the negative linear relationship of the embeddedness dimension and the openness index. As is shown, those nations that have lower scores on embeddedness (e.g., Turkey, Russia, Poland, China, and South Korea) are represented in the bottom-right corner of the figure and have the lowest scores in the openness index, and vice versa. However, Mexico is an outlier here. Of the countries included in this research, Mexico has the highest embeddedness score, but has a moderate score in the openness index. This will be discussed in the discussion section of this paper.

Figure 3 shows the linear relationships of affective autonomy (dimension of national culture) and the connectivity indicator. As can be seen, those nations that have high scores on affective autonomy (e.g., Austria, United Kingdom, Denmark, the Netherlands, and Sweden),

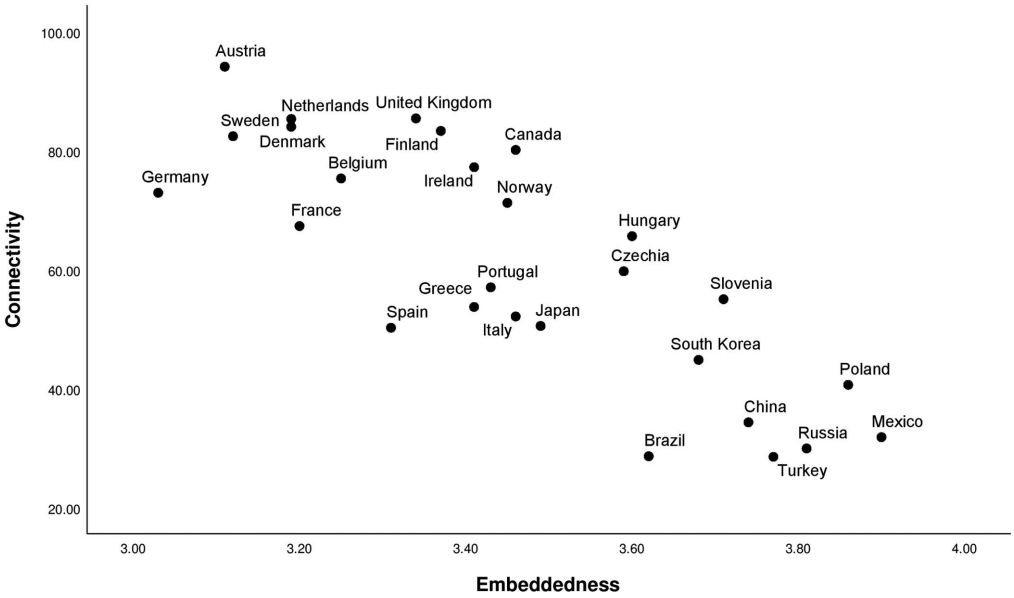


**Figure 1.** The scatterplot of embeddedness of nations against connectivity indicator ($\rho = -0.80$, $p < .001$).

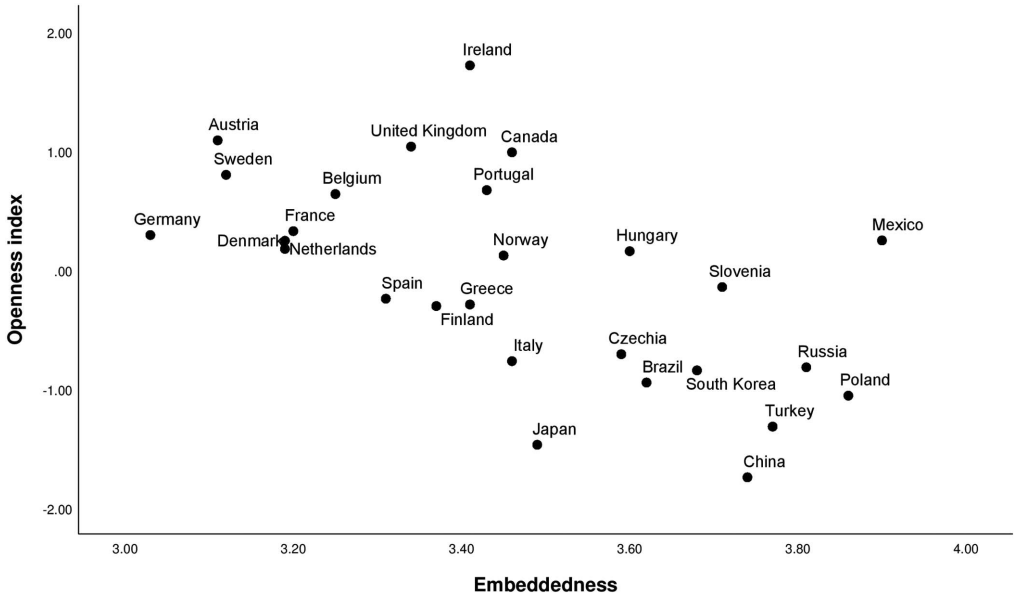


**Figure 2.** The scatterplot of embeddedness of nations against openness index ($\rho = -0.64$, $p < .01$).

have high scores on connectivity, and are grouped in the top-right corner of Figure 3. Furthermore, those nations that have lower scores on affective autonomy (e.g., Mexico, China, Turkey, Russia, Brazil, and Poland) are positioned in the bottom-left corner of the figure and also have low scores on connectivity.

Figure 4 depicts the linear relationships of affective autonomy of nations and their academic openness measured by the openness index. The revealed patterns in Figure 3 are also visible in Figure 4, that is, the higher the affective autonomy of a nation, the higher the

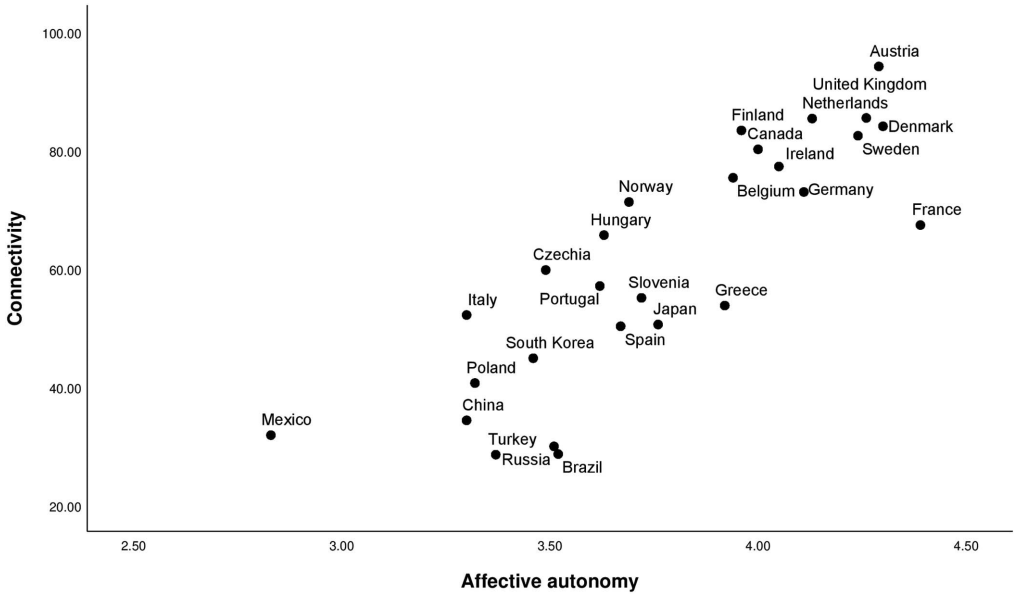


**Figure 3.** The scatterplot of affective autonomy of nations against the connectivity indicator ($\rho = 0.84$, $p < .001$).

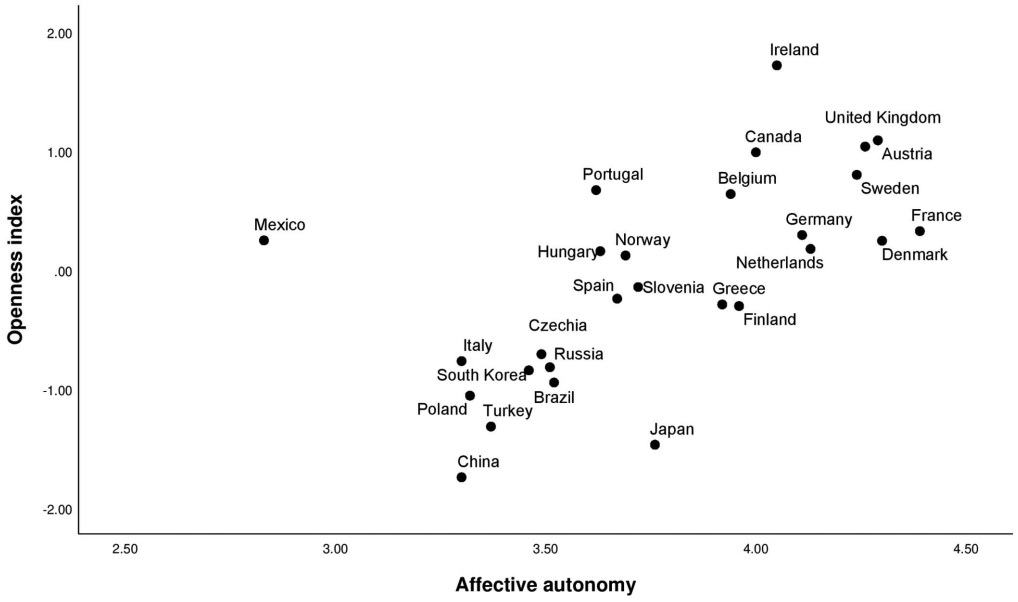


**Figure 4.** The scatterplot of affective autonomy of nations against the openness index ($\rho$ = 0.69, $p$ < .001).

openness of that nation. However, Mexico is also an outlier here. Although the country has the lowest score on affective autonomy in comparison with other included countries, it is not positioned together with those nations that have similar scores on this cultural dimension.

## 5. DISCUSSION

The aim of this research was twofold: to investigate the relationships of certain sociocultural factors with the academic openness of nations, and to examine the unique share of national culture values in the academic openness of countries.

Our study indicated that when all sociocultural factors were simultaneously included in the analysis, a number of national culture values and the resources of nations were stable correlators of academic openness indicators (represented by the connectivity indicator and openness index). We regarded the correlations of a variable with both (not one) academic openness indicators as "stable."

Of the included national culture values, embeddedness, hierarchy, affective autonomy, intellectual autonomy, and egalitarianism were stable correlators of academic openness. Specifically, those nations that had high scores on embeddedness (in other words, little autonomy) and hierarchy had low academic openness. Affective autonomy, intellectual autonomy, and egalitarianism had positive correlations with academic openness, which in practice means that having autonomy makes for being more available. How possible it is to explain the reasons for this in detail is limited. It could nevertheless be an indication that on the question of the positive and negative sides of openness, as discussed in the introduction, this is mainly in accordance with arguments for the *positive* effects of openness.

Furthermore, our analyses reveal stable relationships of two factors of national academic resources with the academic openness of countries. The nations that had higher numbers of researchers (per million inhabitants) and the more productive nations (those with higher number of publications per million inhabitants) were more likely to have higher levels of academic openness, and vice versa.

Our data did not reveal a stable direct relationship between economic resources (i.e., GERD and GERD per researcher) and the academic openness of nations. This means that although more money does not automatically lead to more openness and collaboration, enough money allocated to support research and development sectors (e.g., total researchers per million inhabitants, publications per million inhabitants) is a prerequisite for the progress of academic systems and the openness of nations. Of the investigated countries in this research, Japan, South Korea, Slovenia, and China have relatively high GERD (as a percentage of GDP) and low academic openness, and nations such as Brazil, Turkey, Russia, Poland, Mexico, and Greece have relatively low GERD and low academic openness. The funding bodies in countries that have high GERD and low academic openness (e.g., Japan, South Korea, Slovenia, and China) could prioritize research projects that are internationally collaborative, without sacrificing nationally critical research problems in favor of solely international collaboration. In addition, as academic openness has been regarded as a major contributor to the scientific performance of nations (e.g., Wagner & Jonkers, 2017), the higher education institutions of the countries mentioned could emphasize the importance of the academic openness of researchers (nationally/internationally collaborative projects, mobility programs, etc.) in institutional policies, and provide incentives for researchers (grants, promotion, etc.). For those countries that have limited economic resources for research, low academic openness is not unexpected. Research funding is a major building block of science and development, and when money is limited, national projects would normally be prioritized and mobility opportunities for researchers would also be limited.

The positive relationships between the number of publications and researchers of a nation and academic openness are in accordance with previous research, such as that of Abramo, D'Angelo, and Di Costa (2009) and Kyvik and Reymert (2017), who showed the associations of the quantity or quality of academic publications and academic collaboration. The other explanation for this correlation would be that the open nations attract more researchers.

The second aim of our research was to examine the possible unique share of a set of national culture values in the academic openness of nations. We found that the two national culture values of embeddedness and affective autonomy were stable correlators of the academic openness of nations after controlling for the possible effects of other (economy and resources) factors. These findings show that national culture is a contributing factor to the academic openness of nations. This is in accordance with Acosta et al. (2011), who showed that nations with similar cultures were more likely to cooperate, and Mattessich and Monsey (1992), who showed that similar values promote successful cooperation. When openness, as this indicates, means in practice that cultures that are already more or less similar cooperate mainly among themselves, this may, in fact, be an argument for those who are more skeptical of greater academic openness. If *open* is used in the common sense of the word, this openness is perhaps not so open after all. Put plainly, one tendency is that the economy plays a significant role, which means that researchers in wealthy countries and institutions tend to choose cooperation with partners in more or less equally wealthy nations.

The relationships of these two cultural dimensions with both academic openness indicators in this research (except Mexico) seems to be linear. Mexico was correctly positioned together with other nations that had high embeddedness and low affective autonomy; however, the scores of Mexico in the two applied indicators of academic openness (the openness index and connectivity indicator) were very different. We explored the raw data that were the basis of computation for the two academic indicators used in this research to investigate this deviation. We found that Mexico was an outlier in the openness index data but not in the connectivity indicator data. Further investigation of the openness index data showed that

Mexico was ranked very high in some items of the openness index such as the percentage of mobile researchers (ranked higher than Spain, Finland, the Netherlands, Norway, and many others), which could possibly distort the score of this country on the openness index.

### 5.1. Limitations and Supplementary Factors

This study has some limitations. First, quantifying national culture into a number of categories has been criticized in studies (e.g., Baskerville, 2003; Majima & Savage, 2007), a point we certainly acknowledge. There are, of course, also variations regarding how unified the values within one nation are, so the notion of "a nation's values" may be imprecise. Therefore, it is important to make clear that the categories used are not to be considered as universal truths about the nature of a certain national culture, but rather, as the theories also state, as indicators that can be meaningful in certain contexts. Furthermore, the conclusions based on statistical analysis can be considered "soft" because they are subject to several sources of uncertainty and potential bias, such as sampling variability (statistical analyses are often based on a sample of data, rather than the entire population), model assumptions (most statistical analyses rely on certain assumptions about the data, such as normality or homoscedasticity, which may not always be met in real-world data), and confounding variables (many factors can influence an outcome and failure to account for these confounding variables can lead to incorrect conclusions).

There are several interesting questions one could explore in the continuation of our results, but which we, within the scope of this study, cannot answer. The personal abilities and interests of the researchers play a role (Willis & Strivens, 2015), yet our study does not tell us about the inducement of any individual researcher. A closer look at structures and tendencies of academic openness at the micro (individual) level, such as that of Tierney and Lanford (2014), could bring us further into questions of the motives behind personal openness, and lead us to ask questions of to what degree factors such as trying to attain funding and/or tenure play into the picture. Finally, it is worth mentioning that academic openness could be influenced by the "Matthew Effect," named after the parable of the talents in the Bible (Matt. 29:25); the principle that whoever has, will get more, and vice versa. This is in accordance with Khosrowjerdi, Zeraatkar, and Hajipour (2012), who found out that top universities were more likely to collaborate with universities of similar ranks. Bentley and Kyvik (2012, p. 534) also address the shifts in how universities are funded, another factor that certainly may have a bearing on openness.

## 6. CONCLUSION

These relationships between sociocultural factors and the academic openness of nations—what do they tell us, and what relevance do they have? In accordance with the applied quantitative methods in this study, there is perhaps a twofold answer. On the one hand, the results are in themselves a conclusion: Our hope is that these findings may have some implications for engaging actors in science communication. The results tell us what factors may be associated with openness and that some cultural factors correlate with openness, as well as the status of given countries in this picture, which, both separately and together, contributes information in relation to science studies as well as pedagogy. In continuation of this, our findings support both sides of the opinions about academic openness: There are certainly positive and important sides to it, yet some of the more guarded arguments seem to have validity as well. In particular, our findings show that openness can be a relative term, as exchange and cooperation chiefly happen between cultures and institutions with similar

values and little economic distance. This can lead us to ask: To whom is the culture and exchange of knowledge then really open?

A major and stable finding of this research is that embedded cultures were more likely to have lower academic openness, and autonomous cultures had better rankings on academic openness. In both embedded and autonomous cultures, researchers need funding, but researchers in autonomous cultures have a "choice" to select and pursue a research project and to "decide on the research direction" (Zalewska-Kurek & Harms, 2020). This self-expression (or the right to select/reject) has been a major contributor to the scientific performance of nations (Khosrowjerdi & Bornmann, 2021). This finding has further implications, some of which were analyzed in connection with the themes presented in the introduction. For example, it shows part of the reasons why academic openness has some overlap with academic freedom. All of these cannot be elaborated within the scope of this study, so a general conclusion could be, as Schwartz makes clear: "When we think of our values, we think of what is important to us in life" (Schwartz, 2012, p. 3). This also goes for research, as well as pedagogy: What is important to us as professionals, and what is important to us as people, will often be in sync. The things we place emphasis on reflect what we find important and central within our field. How the respective societies we live and work in inform, shape, and influence the choices and values of researchers is not given, nor is meant to be given, a definite answer by our study, but can nevertheless be a small piece of this important and changeable picture.

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## AUTHOR CONTRIBUTIONS

Mahmood Khosrowjerdi: Conceptualization, Data curation, Methodology, Visualization, Writing—original draft, Writing—review & editing. Silje Hernæs Linhart: Conceptualization, Methodology, Writing—original draft, Writing—review & editing.

## COMPETING INTERESTS

The authors have no competing interests.

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## DATA AVAILABILITY

The data that support the findings of this study are openly available in the links provided in references below: Schwartz (2008), Spanish National Research Council (CSIC) Cybermetrics Lab (2020), UNESCO (2013), Wagner (2018), and Williams and Leahy (2020).

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