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RESEARCH NOTE

National culture as a correlate of research impact and productivity [version 1; peer review: 2 approved with reservations]

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V1 First published: 28 Feb 2019, 8:237
<https://doi.org/10.12688/f1000research.18283.1>
 Second version: 24 Sep 2019, 8:237
<https://doi.org/10.12688/f1000research.18283.2>
 Latest published: 07 Feb 2020, 8:237
<https://doi.org/10.12688/f1000research.18283.3>

Abstract

National culture has been overlooked in discussions related to research productivity and impact owing to individual, socio-political structure, and economic factors. This study shows the relationships between the dimensions of cultural value orientation of the nation and research performance indicators. More than 60 countries were included and Pearson correlation analysis was employed. The variables were taken from Geert Hofstede and Scimago Journal & Country Rank worksheets. This study found that (1) Individualism has significant correlations with the majority of the indicators; (2) Power distance and indulgence correlate with a country's research impact in the form of citation per document; (3) Masculinity, long term orientation, and uncertainty avoidance do not correlate with the indicators. Owing to the fact that the national culture is relatively enduring, countries need to measure their elasticity of hopes and action plans in an effort to boost research productivity and impact, by integrating the national culture in the estimate.

Keywords

research impact, research productivity, national culture, individualism, indulgence, power distance, citations per document, self citations

Open Peer Review

Approval Status

	1	2
version 3		
(revision)	view	view
07 Feb 2020		
version 2		
(revision)	view	view
24 Sep 2019		
version 1		
28 Feb 2019	view	view

1. **Jonathan P. Tennant** , IGDORE, Berlin, Germany

2. **Ludo Waltman** , Leiden University, Leiden, The Netherlands

Any reports and responses or comments on the article can be found at the end of the article.

This article is included in the **Research on Research, Policy & Culture** gateway.

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Author roles: Abraham J: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Resources, Writing – Original Draft Preparation, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: The author(s) declared that no grants were involved in supporting this work.

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How to cite this article: Abraham J. **National culture as a correlate of research impact and productivity [version 1; peer review: 2 approved with reservations]** F1000Research 2019, **8**:237 <https://doi.org/10.12688/f1000research.18283.1>

First published: 28 Feb 2019, **8**:237 <https://doi.org/10.12688/f1000research.18283.1>

Introduction

Makri (2018) recently released a report on the increasing number of publications in various countries. She stated that it's unclear what has triggered and driven the strong gains in Egypt and Pakistan. Throughout the report, various variables believed to be responsible for the increasing number of publications, such as indexation duration, funding, global engagement, international collaboration, and political policies on science and higher education, are explained.

Several predictors of research productivity and impact had been identified, i.e. author characteristics, co-authorship networks, citation history, journal impact factors, twits (Xiaomei *et al.*, 2017), cohort effects (in terms of scientific discipline), age, career stages, gender, the country of origin of the PhD holders, and reward structure of the research enactment (Claudia & Francisco, 2007). They are mostly at the individual and institutional level. At the country level, the predictors are the number of universities, GDP per capita, control of corruption, civil liberties (Mueller *et al.*, 2016), country's wealth and population size, country's value of research tradition, tenure and promotion criterion, experimental costs, IRB (Institutional Review Boards) review flexibility, language barrier, and the training of new young researchers (Demaria, 2009).

However, national cultural orientation is yet to be analyzed, with the present study assuming that individual, institutional, and structural factors are also influenced by the cultural values of a nation. Hofstede Insights (2019) defined culture as the collective mental programming of the human mind which distinguishes one group of people from another, consisting of six dimensions, i.e. (1) power distance (PD) – acceptance on the unequal power distribution in a society; (2) uncertainty avoidance (UA) – intolerance of ambiguity and uncustomary thoughts and practices; (3) individualism (IND) – projection of individuals' "I" in a society rather than "we" (collectivism); (4) masculinity (MAS) – the toughness and competitiveness rather than the tenderness and cooperativeness (femininity) orientation; (5) long term orientation (LTO) – the society's preference of time-honored rather than pragmatic approaches (short term normative orientation); and (6) indulgence (IVR) – the society facilitation towards a fun and enjoyable life rather than restraint (suppression of needs gratification by strict social norms).

National culture is relatively stable (Maseland & van Hoorn, 2017) and is widely used to explain various performances at the country level, such as learning and academic performance (Signorini *et al.*, 2009). The present study hypothesized that there are correlations between the national culture dimensions and research performance indicators. The research performance is assumed to be mediated by research culture, and the culture experiences stimulations and challenges from the national culture; as happened in China, the bureaucratic (high power distance) and nepotistic culture suppresses an innovative and meritocratic research culture (Shi & Rao, 2010).

Methods

All following data were retrieved on December 18, 2018 and compiled into a worksheet (see Underlying data (Abraham, 2019))

as the material of this present analysis. Countries' research impact (citations per document/CPD, citations, self-citations) and productivity (total documents) were obtained from the Scimago Journal & Country Rank (<https://www.scimagojr.com/countryrank.php?out=xls>), while national cultural orientations (*pdi*=power distance, *idv*=individualism, *mas*=masculinity, *uai*=uncertainty avoidance, *ltowvs*=long term orientation, *ivr*=indulgence) were acquired from Geert Hofstede web site (<https://geerthofstede.com/wp-content/uploads/2016/08/6-dimensions-for-web-site-2015-08-16.xls>). Pearson product-moment correlation analysis was conducted using IBM SPSS Statistics version 20 for Windows.

Results

The descriptive and correlational statistics are presented in Table 1 and Table 2. As shown, among 68 countries, IND is positively correlated with CPD ($r=0.506$, $p<0.01$), total documents ($r=0.351$, $p<0.01$), citations ($r=0.405$, $p<0.01$), and self-citations ($r=0.304$, $p<0.05$). MAS, UA, and LTO do not correlate with these four. PD ($r=-0.555$, $p<0.01$, $N=68$) and IVR ($r=0.480$, $p<0.01$, $N=91$) correlate with CPD. Total documents, citations, and self-citations correlate with each other with $r>0.90$, $p<0.01$, $N=239$. CPD is positively, but weakly, correlated with total documents, total citations and total self-citations, with $r<0.20$, $p<0.05$, $N=239$.

Among 54 countries, even after controlling the Log GDP per capita (taken from the World Happiness Report), the correlations between IND and CPD ($r=0.439$, $p<0.01$), total documents ($r=0.268$, $p<0.05$), and citations ($r=0.320$, $p<0.05$), between PD and CPD ($r=-0.504$, $p<0.01$), as well as between IVR and CPD ($r=0.411$, $p<0.01$) persist (see Table 3).

Table 1. Descriptive statistics of research impact (CPD, CIT, SELF) and productivity (DOC) as well as national culture dimensions (PD, IND, MAS, UA, LTO, IVR).

	<i>M</i>	<i>SD</i>	<i>N</i>
DOC	204893.92	878342.00	239
CIT	3558474.20	19007535.44	239
SELF	1076044.63	8178012.17	239
CPD	13.35	6.15	239
PD	59.12	22.02	68
IND	43.85	24.16	68
MAS	48.60	19.96	68
UA	67.13	23.26	68
LTO	46.05	24.30	90
IVR	45.41	22.56	91

DOC = Total documents; CIT = Total citations; SELF = Total self-citations; CPD = Citations per document; PD = Power distance; IND = Individualism; MAS = Masculinity; UA = Uncertainty avoidance; LTO = Long term orientation; IVR = Indulgence

Table 2. Correlations results between national cultures dimensions and research impact and productivity.

		DOC	CIT	SELF	CPD	PD	IND	MAS	UA	LTO	IVR
DOC	<i>r</i>	1	0.958**	0.933**	0.153*	-0.144	0.351**	.213	-0.194	0.124	0.088
	<i>p</i>		0.000	0.000	0.018	0.241	0.003	0.082	0.113	0.246	0.405
	<i>N</i>	239	239	239	239	68	68	68	68	90	91
CIT	<i>r</i>		1	0.977**	0.196**	-0.209	0.405**	0.165	-0.174	0.040	0.146
	<i>p</i>			0.000	0.002	0.088	0.001	0.178	0.156	0.710	0.168
	<i>N</i>		239	239	239	68	68	68	68	90	91
SELF	<i>r</i>			1	0.142*	-0.135	0.304*	0.146	-0.157	-0.004	0.107
	<i>p</i>				0.028	0.273	0.012	0.235	0.200	0.970	0.311
	<i>N</i>			239	239	68	68	68	68	90	91
CPD	<i>r</i>				1	-.555**	0.506**	-0.084	-0.185	-0.084	0.480**
	<i>p</i>					.000	0.000	0.494	0.130	0.430	0.000
	<i>N</i>				239	68	68	68	68	90	91

DOC = Total documents; CIT = Total citations; SELF = Total self-citations; CPD = Citations per document; PD = Power distance; IND = Individualism; MAS = Masculinity; UA = Uncertainty avoidance; LTO = Long term orientation; IVR = Indulgence

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

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

Table 3. Partial correlations results between national cultures dimensions and research impact and productivity, controlling Log GDP per capita (LGDP).

Control Variables			DOC	CIT	SELF	CPD	PD	IND	IVR
LGDP	DOC	<i>r</i>	1.000	0.954	0.940	0.218	-0.019	0.268	0.031
		<i>p</i>		.000	0.000	0.106	0.887	0.046	0.819
		<i>N</i>	0	54	54	54	54	54	54
	CIT	<i>r</i>		1.000	0.984	0.303	-0.083	0.320	0.099
		<i>p</i>			.000	0.023	0.541	0.016	0.468
		<i>N</i>		0	54	54	54	54	54
	SELF	<i>r</i>			1.000	0.222	-0.047	0.253	0.079
		<i>p</i>				.010	0.730	0.060	0.564
		<i>N</i>			0	54	54	54	54
	CPD	<i>r</i>				1.000	-0.504	0.439	0.411
		<i>p</i>					.000	0.001	0.002
		<i>N</i>				0	54	54	54

DOC = Total documents; CIT = Total citations; SELF = Total self-citations; CPD = Citations per document; PD = Power distance; IND = Individualism; MAS = Masculinity; UA = Uncertainty avoidance; LTO = Long term orientation; IVR = Indulgence

Discussion

The positive correlations between IND and CPD, total documents, citations, and self-citations could be explained using the findings of Deschacht & Maes (2017). They found that in countries with more individualistic cultures: (1) the scientists prioritize their self-development, (2) the records of scientific work are historically longer (usually Western countries), and (2) self-citations flourish more. This does not necessarily mean that there have been citation abuses, but that self-citation is used to refer to their prior works, thereby, preventing unnecessary repetitions of ideas in newer works (Deschacht, 2017). Although IND

and collaboration are often contested (e.g. Kemp, 2013), a “collaborative individualism” (Limerick & Cunningham, 1993) – stressing both working together and self-emancipation – is possible, explaining the positive correlation.

PD has a negative correlation with CPD. In this case, PD might manifest itself in academic writing in the form of rigid, authoritative, defensive, and dogmatic styles (Koutsantoni, 2005). In addition, PD negatively correlates with democracy (Maleki & Hendriks, 2014). The lower level of democracy reduces the opportunity of the academic community to exchange

and market (in the broad sense) scientific information, as well as debate openly. Likewise, democracy that does not flourish deters the use of research results in creating public policies. In addition, science is co-opted or used as just a tool to achieve exclusive interests by ideologues, pundits and political leaders; they ignore the state-of-the-art nature of the research (Branscomb & Rosenberg, 2012). All the conditions could reduce CPD.

IVR is positively correlated with CPD; this may be because IVR facilitates academic freedom (Ohmann, 2011) and manifests itself in a “lovely” academic writing style (Kiriakos & Tienari, 2018). This style is not dry and cold, but rather dialogical, humanistic, more reflexive, and capable of showing authors’ courage and vulnerability. Compelling insights are more easily born from the writings that embody those qualities; as mentioned, “a thin line exists between interesting insights and self-indulgence” (Nadin & Cassell, 2006, p. 214). Scientific authors who read such works would be attracted to cite them, leading to an increase in the works’ CPD. In addition, “strategic indulgence” is possible and known to be a creative process that enables one to balance academic activity (such as writing) with non-academic ones (Jia *et al.*, 2018) – fostering insight.

The weak correlation between CPD and other research performance indicators shows that CPD is more difficult to manipulate or be an object of the author’s “engineering”.

Conclusion

National culture dimensions, especially individualism, power distance, and indulgence, are pivotal variables that are to be considered in justifying research impact and productivity. National culture can be integrated as a moderating variable in the predictive relationship between GDP per capita and research

impact and productivity. Diversification of this study – based on the document and authors’ collaboration types, the indexing databases, the disciplines, the open science practices, as well as the history and development of the research in a country – is a future opportunity for further study.

Data availability

Source data

Geert Hofstede: Dimension data matrix. <https://geerthofstede.com/research-and-vsm/dimension-data-matrix/> (Hofstede *et al.*, 2010)

Scimago Journal & Country Rank: Download data. <https://www.scimagojr.com/countryrank.php?out=xls> (Scimago Lab, 2018)

World Happiness Report 2018: Chapter 2: online data. <https://s3.amazonaws.com/happiness-report/2018/WHR2018Chapter2-OnlineData.xls> (Helliwell *et al.*, 2018)

All source data was accessed and retrieved on the 18/12/2018

Underlying data

Figshare: National culture, research performance indicators, and log GDP Per capita. <https://doi.org/10.6084/m9.figshare.7723211> (Abraham, 2019)

Data are available under the terms of the [Creative Commons Zero “No rights reserved” data waiver](#) (CC0 1.0 Public domain dedication).

Grant information

The authors declared that no grants were involved in supporting this work

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[Publisher Full Text](#)

Open Peer Review

Current Peer Review Status: ? ?

Version 1

Reviewer Report 15 April 2019

<https://doi.org/10.5256/f1000research.20000.r46347>

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Ludo Waltman

Centre for Science and Technology Studies (CWTS), Leiden University, Leiden, The Netherlands

This is a short paper that presents a brief but easy-to-understand analysis of the correlation between the cultural orientation of countries and countries' scientific performance in terms of bibliometric statistics.

It would be helpful if the author could offer more extensive information on the way in which the variables used in the analysis have been obtained. The definitions of the bibliometric variables need to be carefully explained. Likewise, it should be explained how the variables for national cultural orientations have been obtained.

The statistical analysis is carried out using Pearson correlation analysis. Before presenting the correlations, the author should present descriptive statistics for the variables included in the analysis. In particular, I would like to know whether some of the variables may be highly skewed. If this is the case, the use of Pearson correlation analysis could easily lead to misleading results. The use of for instance the Spearman correlation may then be more appropriate.

The author relies strongly on statistical significance testing. My recommendation is to leave out all significance tests and instead to present confidence intervals for the correlation coefficients. Significance testing leads to problematic dichotomous thinking, as has for instance been pointed out in a recent contribution in Nature (Amrhein et al.¹). Following the so-called estimation statistics approach, reporting confidence intervals is preferable over reporting significance tests (https://en.wikipedia.org/wiki/Estimation_statistics). I am aware that another reviewer (Tennant) recommends performing even more significance tests. I disagree with this recommendation. I don't consider this to be good statistical practice.

It would be nice if the author could deepen the analysis a bit more. This can for instance be done by showing scatter plots for the most interesting relationships between variables. In these scatter plots, the names of countries could be shown, especially for those countries that seem to display interesting behavior (e.g., outliers). This would lead to a more in-depth analysis that probably offers richer insights.

The paper uses lots of abbreviations. This makes the paper more difficult to read. My recommendation is to reduce the number of abbreviations that are used. It may also be helpful to include a table listing all abbreviations and the corresponding full terms.

The author interprets the analysis in terms of correlation instead of causation. This is very good. There is a risk, however, that some readers may give causal interpretations to the findings of the author. My suggestion is to add a sentence at the end of the paper emphasizing that causal interpretations are not warranted.

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1. Amrhein V, Greenland S, McShane B: Scientists rise up against statistical significance. *Nature*. 2019; **567** (7748): 305-307 [Publisher Full Text](#)

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: I am an expert in scientometrics. I don't have any specific expertise on the cultural orientation of countries.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 28 March 2019

<https://doi.org/10.5256/f1000research.20000.r46349>

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Jonathan P. Tennant

IGDORE, Berlin, Germany

The author presents an interesting piece of insight into research impact through a cultural lens, which is quite distinct from a lot of more recent studies which tend to focus on 'academic impact' metrics. As a short note, I found it useful in exposing a different dimension to the ongoing debates around research impact. Given my area of "expertise", I feel that someone who understands social research impact more could provide a great deal of additional insight here during the review process.

Data

- The data are included in Figshare, as well as summarized in integrated tables.
- I note that there are a lot of missing data included though, is this just a case of availability?
- Also, I note that the Scimago database is based on Scopus data, which tends to be biased in a number of dimensions. Is it possible to make a note of this?

Abstract

- The abstract jumps right into results around Individualism and Power distance and indulgence, without describing what these are (even briefly). This makes it difficult to understand for readers who are perhaps unfamiliar with these concepts. Perhaps a brief explanation of these could be added instead of describing the methods and the data sources, which aren't really needed?

Introduction

- Just to pull out the 'correlation does not imply causation' card here; just because there is a correlation between number of publications and other external factors, does not imply a causal relationship necessarily.
- There are a couple of typos (e.g. 'twits') that might just need a quick copy edit to fix.
- I think the Introduction does a nice job of describing the previous research, and situates the present report well within that.
- Not sure if the comment about China at the end of the Introduction adds too much here.

Materials and methods

- So the methods are pretty simple, which is nice. But also, I think perhaps a bit too simple here given that you're performing a lot of bivariate analyses, and a couple of extra steps are recommended.
 - First, you want to perform an assessment of normality for data series prior to any correlation analyses, using the Shapiro-Wilk test (e.g., `shapiro.test` function in R). From the output, if the p-values are greater than the pre-defined alpha level (traditionally, 0.05) this implies that the distribution of the data are not significantly different from a normal distribution, and therefore you can assume normality and use Pearson's test (Pearson's product moment correlation coefficient [r]). If $p > 0.05$, you should instead perform a non-parametric Spearman's rank correlation (ρ).
 - Secondly, once you've done this, for each test, report both the raw and adjusted p-values. The latter can be calculated using the `p.adjust()` function, and using the 'BH'

model (Benjamini & Hochberg, 1995¹). This method accounts for the false-discovery test when performing multiple hypothesis tests with the same data set, which can inflate type-1 error (i.e. in order to avoid falsely rejecting a true null hypothesis; a false positive). What this will probably do is reduce the 'significance' of some of your results too (which is why it's best to report both the raw and adjusted values).

- In addition to this, it seems like you have multivariate data, so multivariate analyses might be more informative here. I would strongly recommend performing a Principal Components Analysis on your data (perhaps just only with the variables with more complete data), and inspecting that as a compliment to the bivariate ones. This is fairly easy to do and display using in built functions in R.

Results

- I expect that the results will change a bit given my above recommendations to the methods, so won't comment too much on them at this stage. The nice thing about PCA though is that it produces good summary plots, which might be useful here.
- In the text, can the country abbreviations be given to make reading a bit easier?
- M, SD, and N I think need explaining here too. Lots of acronyms can get a bit confusing!

Discussion and conclusions

- As above, I don't want to comment too much on the Discussion and Conclusions at the present, as I think the above recommended methods will change some of the interpretations. However, at the present there seems to be a logical progression between reported results and conclusions.

Congratulations to the author on a great and interesting piece of work. I would be happy to see a revised version of this too if needed.

References

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[Reference Source](#)

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Palaeontology, Open Scholarly Communication

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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