A Practical Approach to Measuring Cultural Diversity on Australian Organizations and Schools

Rezza Moieni, Peter Mousaferiadis, and Carlos Oscar Sorezano

***Abstract*—Although there is an abundance of academic literature addressing the importance of cultural diversity, there is a significant lack of discussion afforded to actual methodologies employed when measuring diversity. Our research comprises the development of a set of quantifiable dimensions of diversity that can be benchmarked, compared over time, evaluated against adjustable variables and used to provide recommendations. Our research begins with a literature review to assess existing models for measuring diversity. This data is used to identify a model of measurement that allows for the quantification of three key parameters that constitute cultural diversity: ethnicity, language and belief. In this paper, we will review current methods used to measure cultural diversity, which provides the background for the introduction of our newly developed index for measuring the cultural diversity of groups based on three distinct parameters of the ethnicity, language and worldviews (beliefs) of community members. This index has been developed for implementation in a digital tool called Ancestry Atlas that provides visual insights to the diversity of particular groups.**

***Index Terms*—Cultural diversity, diversity measures, ancestry atlas tool.**

I. Introduction

Establishing the awareness for the importance of Cultural Diversity in communities has long been a challenge. Today though, there is one more challenge: How to measure Cultural Diversity in a community. While aspects of Cultural Diversity and its importance have been well thought of, there are only few methods which measure it in organizations and schools. Other impacts of diversity such as sexual orientation, gender, physical disability and skin color are also addressable in this index in a similar way. The index is based on the weighted normalized entropy of ethnicities, languages and worldviews of a community. The index has been implemented in a tool named Ancestry Atlas. Finally, the discussed method is applied to measure the cultural diversity in one sample organization in Australia.

II. Importance of Measuring Cultural Diversity

UNESCO's definition states that "[Culture] is that complex whole which includes knowledge, beliefs, arts, morals, laws, customs, and any other capabilities and habits acquired by [a human] as a member of society [1]. Also, diversity as a general term means the state of dissimilarity. However, when it comes to practice, it needs a measurable metric to address this dissimilarity. Recently, cultural diversity has become a hot topic among researchers and those policy makers. Many different aspects of cultural diversity have been well discussed and reviewed. Numerous studies by firms such as Deloitte and McKinsey have identified multiple advantages generated by organizations who commit to diversity and inclusion including**:**

- Higher management team performance [2]
- Higher achieving teams [3]
- Innovation [4]
- Attracting new talent [5]
- Market insight [6]

The importance of cultural diversity in workplaces, Healthcare and nursing and education and schools have been addressed in many researches [7]-[10]. However, the term "cultural diversity" has been poorly defined, "analytically neglected" and in need of "systematic or robust understandings" [11], [12]. There are some cultural frameworks and different measurement indicators, which focus on one aspect of culture only.

III. Elements of Cultural Diversity

While the term "diversity" is an inclusive concept, when it comes to cultural studies and it may cover gender balance, sexual orientation and disabilities, we consider them as other perspectives of diversity which can be a result of cultural diversity as well. In this paper, we consider that main elements of cultural diversity are ethnicity, worldviews1 and linguistics. Also, complexity of defining ethnicity makes its measurement even trickier. The races and ethnicities of ancestors also have important effects too. In this paper, we consider Ethnicity (here; Country of birth), linguistics and worldviews (beliefs) as main elements of cultural diversity. Different group of people have different viewpoints on importance of these elements. We did a survey on this and the results show that while people from France believe that beliefs of people in a community has an impact of 15% on cultural diversity of that group, our similar survey showed that a group of people from Pakistan believe that diversity of beliefs has an impact of 60% (average) on cultural diversity of a given community. In other words they believe that variety of beliefs in a community is a more important factor of cultural diversity than linguistics or ethnic diversity. For this paper, we did a survey on 200 people from 30 different backgrounds and the study shows that as an average, they

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[1] The simplest definition of worldview is what someone thinks about the world or how they might try to interpret the reality of the world they live in. From a philosophical and conceptual perspective worldviews describe all living things and their place in the world and are framed by attitudes and ideas about the world, ourselves and life. Worldviews are underpinned by value based systems that attempt to provide answers for humanity's existence

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believe that ethnicity diversity has 52%, linguistic has 22% and belief diversity has a weight of 26% on cultural diversity of communities. We will use these weights in section V when we introduce our index for cultural diversity based on normalized Entropy value of these three elements

$$\begin{cases} \text{Ethnicity} - 52\% \\ \text{Linguistics} - 22\% \\ \text{Worldviews} - 26\% \end{cases} \quad (1)$$

The weights in Eq. (1) may vary during the time and different groups of people might think of different weights.

IV. A Brief Review of Measuring Methods and Cultural Value Frameworks

In this section, we will review some cultural value frameworks and methods of measuring cultural diversity.

A. Ethnic Fractionalization Indices

This method compares levels of ethnic, linguistic and beliefs fractionalization in different countries. Data fractionalization is a commonly used term in economic literature [13]. In measuring cultural diversity, this method is about computing the probability of 2 people chosen randomly in a country that are not from the same ethnic, linguistic or belief background. Fearon [14] and Alesina [15] have developed similar measures of ethnic. Alesina [15] adopt his method based on the country breakdown suggested by original sources, mainly the Encyclopedia Britannica. This index has been criticized as Britannica only provides list of ethnicity for 124 countries so Alesina had to use other resources for the rest of countries. Fearon [14] instead is trying to construct the ”right list” of ethnic groups which ”depends on what people in the country identify as the most socially relevant ethnic groupings”. and Both these methods are based on one time experiment while the data may change over the time. [14]

Alesina[13], introduced Fractionalization index as following:

$$\text{FRACT}_j = 1 - \sum_{i=1}^{N} {S_{ij}}^2 \quad (2)$$

where S_{ij} is the share of group I (i=(1,2,…N))in the jth country. [13] Table 1 and 2 show the ten most and the ten least fractionalized countries in Africa(, based on Posner's index called PREG for Politically Relevant Ethnic Groups and ELF for ethnic fractionalization [20])

TABLE I: Ten Most Fractionalized Countries in Africa [20]

PREG		ELF	
Zaire (DRC)	0.80	Tanzania	0.93
Cameroon	0.71	Uganda	0.90
Zambia	0.71	Zaire	0.90
Chad	0.66	Cameroon	0.89
Nigeria	0.66	South Africa	0.88
Angola	0.65	Nigeria	0.87
Uganda	0.63	Cote d'Ivoire	0.86
Liberia	0.62	Chad	0.83
Mauritius	0.60	Kenya	0.83
Tanzania	0.59	Liberia	0.83

TABLE II: Ten Least Fractionalized Countries in Africa [20]

PREG		ELF	
Botswana	0.00	Burundi	0.04
Burkina Fasoana	0.00	Madagascar	0.06
Lesotho	0.00	Somalia	0.08
Madagascar	0.00	Rwanda	0.14
Seychelles	0.00	Lesotho	0.22
Somalia	0.00	Mauritania	0.31
Swaziland	0.00	Botswana	0.51
Guinea-Bissau	0.05	Zimbabwe	0.54
Mali	0.13	Mauritius	0.58
Senegal	0.14	Benin	0.62

B. Hofstede's Cultural Dimension Theory

Hofstede's framework describes the effect of society's culture on the values of its members and uses a factor analysis to show how these values are related to the members of any community [15]. Hofstede's method was initially based on Schwartz research on individualism and collectivism [16]. Hofstede was focusing on cultures output to the business. Hosfstede has introduced a set of dimensions that can be measured using surveys to obtain the average values for a set of people and from that a measure of their national culture attributes. These cultural dimensions are long term orientation (LTO), Masculinity (MAS), Individualism (IDV), Power Distance (PDI), Uncertainty Avoidance (UAI) and Indulgence vs. restraint (IND). Putting together national scores (from 1 for the lowest to 120 for the highest), Hofstede's six-dimension model allows international comparison between cultures, also called comparative research . According to Hofstede's study, Latin, Asian, African countries and Arab countries have the highest PDI index while Angelo and Germanic ones have the lowest one. And UAI scores are the higher in South and East part of Europe, South American countries and also Japan while Anglo, Nordic, and Chinese culture countries have the lowest scores of UDI

C. Cultural Distance

Cultural distance is a function of differences in values and communication styles that are rooted in culture. Distance is created when individuals or groups perceive that their values and communication styles differ from others. National cultural distance was first introduced by Kogut and Singh [17]. Kandogan, et.al [18] later enhanced this method. The method introduces by Kogut and Singh [17] is based on Mahalanobis which is a general form of The Euclidean distance.

$$M_{ij} = \sqrt{\left(I_i - I_j\right)^T S^{-1} \left(\left(I_i - I_j\right)\right)} \quad (3)$$

I_x is the vector for element x with n dimensions as follows

$$I_x = \begin{bmatrix} I_x^1 \\ I_x^2 \\ I_x^n \end{bmatrix} \quad (4)$$

S is the covariance matrix for n dimensions of the space and cultural distance between two cultures is calculated as following:

$$KS_{ij} = \frac{1}{n}\sum_{d=1}^{n}\frac{(I_i^d - I_j^d)^2}{V^d} \quad (5)$$

where *KSij* is the cultural distance between countries of i and j. I_x^d is the index of a country x in the dimension d, V_d is the variance of the index for the dimension d, and 'n' is the number of cultural dimensions. Kogut and Singh [17], showed that Differences in power distance and individualism cause the largest deviation. When a country is higher (or lower) in both dimensions, the Kogut and Singh measure seriously underestimate the distance by as much as 64%. When one country is higher in one of these dimensions and lower in the other, it overestimates the distance by 55%. Table 3. Illustrates cultural difference index based on Kogut and Singh's method [17]

TABLE III: CULTURAL DISTANCE MEASUREMENT FOR SOME COUNTRIES BASED ON KOGUT AND SINGHMETHID [17]

Country i	Country j	KS	± estimate
France	Spain	0.27	−62%
East Africa	India	0.61	−47%
Arab countries	Thailand	0.63	−46%
France	Thailand	1.62	−42%
Arab countries	East Africa	0.46	−41%
Germany	United States	0.50	−40%
Brazil	Germany	1.44	45%
India	United States	1.78	46%
Russia	United States	4.87	52%
Mexico	United States	3.54	58%
Germany	Mexico	2.09	60%
Arab countries	United States	2.68	64%

D. Stirling's Method of Measuring Cultural Diversity

Stirling's method of measuring cultural diversity defines diversity as a mixture of variety, balance and disparity, where the other parameters are equal. Therefore, the bigger these parameters are, the more diversity exists in a community. Stirling's model is one of the most comprehensive models of measuring diversities so far [10]. This model can be applied to one aspect of a group. So, for example, if we claim that cultural diversity consists of diversities from ethnicities, linguistics and beliefs, then Stirling model can model each of them separately.

As the simplest one, Variety means different types of entities exist in a group. Different languages understood in a community can be an example of variety of languages in that group. In Fig. 1, the diversity in the right image is more than the left one.

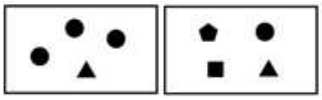

Fig. 1. Variety.

As the second metric in Stirling's index, Balance refers to the way these entities are distributed. So, if in a community, people who are speaking Persian are working in different departments of a company, this company has a more balanced language distribution compared to the situation, all of them were working in the same department of the company. In Fig. 2, the diversity in the right image is more than the one showed in the left.

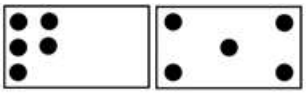

Fig. 2. Balance.

As the last metric, Disparity refers to similarity of existing entities in a given community. So, in our example, Persian and Turkish languages have more similarity compared to Persian and Japanese. So, a group of people who are speaking Persian and Japanese is more diverse than a group of people who are speaking Persian and Turkish. Fig. 3, demonstrates this concept. In Fig. 3, the disparity in the right image, is greater than the left image, hence the diversity is more as well.

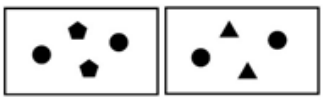

Fig. 3. Disparity.

In this model, Dyen's matrix of linguistic differences can be used as a reference. [21]

By theory, in Stirling's model, each component of diversity can evolve independently. However, if for example more number of people who can speak a certain language join a company, this will change the balance of languages in that group as well. This model first was developed to formulate energy portfolios, finance, and psychology and communication theory [15]. The Stirling definition is being used to defining Stirling Index. This is the sum of pairwise disparities, weighted in proportion to contributions of individual system elements (*D*) [10],

$$\mathrm{D} = \sum_{ij(i<>j)}^{n} \mathrm{d}_{ij} p_i p_j \quad (6)$$

where *pi* and *pj* are proportional representations of elements *i* and *j* in the system (balance) and *dij* is the degree of difference (disparity) attributed to elements *i* and *j*.

V. THE PROPOSED INDEX

A. Assumptions

We consider that cultural diversity is mainly related to ethnicity, worldviews (Beliefs) and languages people know in a specific community. However, having people with different genders, disabilities or sexual orientations can be indicators of diversity as well, but here we focus on only the cultural diversity based on the above three characteristics of the people in a group. Also, for ease of demonstration, we use country of birth as a measure of ethnicity here. Where enough data is available, the proposed method can be used based on races, ethnicities of members or even DNA of the members of the community as well. Here we use normalized Entropy of diversities (Ethnicity, Linguistics and Worldviews), and then will introduced a weighted mean of these 3 indices as a metric for Cultural Diversity Index of a community or group.

B. Proposed Index

We introduce our diversity index based on two numbers:

1) L1 norm (Which is also known as taxicab metric, rectilinear distance or L1 distance) which

is basically the sum of absolute differences. Then we calculate L1/N as the first number we need. Our vector can be shown as VN= (V1, V2…VN. N is the total number of different languages in that group If in a community, there are 5 people who all speak one language, then our vector will be (5,0,0,0,0) and if all speak different languages, it will be (1,1,1,1,1) and if all speak one language plus English, it will be (5,1,1,1,1). Same methid can be used to show variety of beliefs and ethnicities in a community as well

2) The entropy of this vector considered as a probability distribution over the entropy of a "smoothed" vector of the same length considering just N languages Entropy is calculated as following:

$$Entropy = \sum_{i=1}^{k} \mathrm{x}_i \, LOG(\mathrm{x}_i) \qquad (7)$$

where x_i is the probability of existence of i^{th} language (belief or ethnicity) in the group. So if all people speak one different language each in a group of 5 people, the x_i will be 0.2

3) The diversity of linguistics, ethnicities (country of Birth here) and worldviews (Beliefs) can be calculated independently as following :

$$\boldsymbol{Diversity}(E, L \; or \; W) = \frac{\boldsymbol{L1}}{\boldsymbol{N}} \times \frac{\boldsymbol{Entropy\ V}}{\boldsymbol{Entropy\ Smoothed\ V_N}} \qquad (8)$$

where $\boldsymbol{Entropy\ Smoothed\ V_N}$ is the Entropy of normalized V_N. So, in one extreme, when all people of the team are all speaking just one language, or they are all from one ethnicity (or country of birth) or they all believe in the same belief, the above index will be zero and if the number of variety of linguistics, ethnicities or beliefs are equal to the number of people in that team, the diversity will be 1 as the most diverse situation. For calculating the diversity of languages, we assume that the number of languages in one group is equal or less than number of people in that team. This will help keeping the diversity index between 0 and 1. This is not a concern with ethnicity (Country of birth) and beliefs as people only belief in one or they are born on just one place.

Now, we can calculate Cultural Diversity (Ri) based on D_L, D_E and D_w and Eq.1:

$$\text{Cultural Diversity}(R_i) = 0.52\ D_E + 0.22\ D_L + 0.26\ D_w \qquad (9)$$

Example: In a group of 5 people, they all speak English and Persian. Also, they are all born in Australia but they have 5 different worldviews. Here we calculate the cultural diversity of this team as following:

We calculate D_E as following:
v=(5,0,0,0,0)
Entropy(v)=-1*log(1)-4*0*log(0)=0
v_N=(1,1,1,1,1)
smoothed(v_N)=vN+1=(2,2,2,2,2)
Entropy(smoothed(vN))=1
D_E =l1(v)/5*entropy(v)/entropy(smoothed(vN))=0

We calculate D_W as following
v=(1,1,1,1,1)
Entropy(v)=1
v_N=(1,1,1,1,1)
smoothed(v_N)=vN+1=(2,2,2,2,2)
Entropy(smoothed(v_N))=1
D_W =l1(v)/5*entropy(v)/entropy(smoothed(v_N))=1*1=1
We also calculate D_L as following:
v=(5,5,0,0,0)
Entropy(v)=-2*1/2*log(1/2)-3*0*log(0)=0.301
v_N=(1,1,1,1,1)
smoothed(v_N)=vN+1=(2,2,2,2,2)
Entropy(smoothed(vN))=1
D_L
=l1(v)/5*entropy(v)/entropy(smoothed(vN))= D=l1(v)/5* entropy(v)/entropy(vN)=2*0.301=0.602
According to Eq(9),
R_i= 0.52 D_E+ 0.22 D_L+ 0.26 D_w = 0.52 *(0) + 0.22 *(0.301)+ 0.26 *(1) = 0.3262
As the second example, if all peple in a team are from one country and all speak one language only and all believe in the same belief, the R_i here will be 0

VI. CONCLUSION

As a result of identifying the optimal model for quantifying cultural diversity, based on Ethnicities, linguistics and beliefs of a community, we introduced weighted normalized Entropy index. The diversity indices provide a means to calculate benchmarks. Our index also allows for evaluation of the indices against changes in specific variables to visualize the effects of changes in the profile of members, employees and etc. on the overall diversity of an organization or community. The paper has presented and discussed some current methods of measuring cultural diversity, cultural difference and value frameworks. The proposed index to measure cultural diversity, provides a base to show diversity of any community which can be later be used to compare diversities of different communities as well. The index is bounded between 0 and 1. According to the proposed method, when all people believe in the same belief and are speaking the same language and come from the same background, their diversity is zero and on the other extreme side, the cultural diversity index tends to 1 when they all come from different belief, ethnicity and language backgrounds .This index has been implemented in a data visualization tool and is available at www.ancestryatlas.com . Ancestry Atlas enables schools and organizations to visualize and utilize their linguistics, ethnic and religious diversity. The results for an Australian company of 44 staff is available in the index section of this paper.

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