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RC14: Sociology of Communication, Knowledge and Culture

Literacies of XXI Century: Socially Hidden Factors behind Language Skills and STEM Skills. the Predominat Role of Language in Social Stratification

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3. Inductive Process of investigation:
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1. Presentation

In the first State of the Union Address, **George Washington** (1790) promoted scientific knowledge for the wellbeing of the nation by pronouncing,

“Nor am I less persuaded that you will agree with me in opinion that there is nothing which can better deserve your patronage than the **promotion of science and literature**. Knowledge is in every country the surest basis of public happiness. (p. 1)

(Cited in Stevenson, 2014:13)

Heidi J. Stevenson (2014:133) indicates Barack Obamas Policies:

Reaffirming and strengthening America's role as the ***world's engine of scientific discovery and technological innovation*** *is essential to meeting the challenges of this century. That's why I (President B. Obama) am committed to making the improvement of STEM education over the next decade a national priority. (White House, 2009, para. 4)*

Obama supports initiatives as evidenced by his 2013 State of the Union Address, which calls for the training of 100,000 STEM teachers (The White House, 2013). In addition, Obama recognizes the importance of training STEM workers by stating,

We'll reward schools that develop new ***partnerships with colleges and employers****, and create classes that* ***focus on science, technology, engineering, and math–the skills*** *today's employers are looking for to fill jobs right now and in the future. (para. 42)*

Nevertheless and in spite of the political discourse…

(Impresively similar in oficial statements of Presidents Bush, Obama and Trump)

- *High contoversies about what means STEM and who has an STEM Profession* (Charette, 2013 Rothwell, 2013, NAP, 2005; 2010)

- *Another important controversia in literature is that there is not a shortage of STEM workers.* ***There is a surplus.*** Stevenson, H. J. (2014). Salzman, Lowell, and Kuehn (2013), Salzman et al. (2013)

- Moreover… H-1B Visas pressures to decrease wages in technological sectors (Costa, 2012; Eisenbrey, 2013; Matloff in Harkinson, 2013; Salzman, et al., 2013)

- What about Liberal Arts in all this discourse? Read the documents above.

- **The core of our Study is to understand all literacies and their interactions, including STEM and Liberal Arts skills, competences or literacies**

- **Sociologically, what about the relevance of language-literacies in division of labor?**

Sociologically, in late capitalism these new bunch of literacies, **undetermined** in official documents, should be considered in relation to ***division of labor***, a central concept in sociology as new mediating variables in social stratification.

(see an analysis of language and division of labor in classics Smith, Marx, Weber, Durkheim, Simmel, Bourdieu, Elias in Alarcón 2021,2022)

These literacies have many intersectionalities with multilingualism gendered language, racialized language as well, more important here, relations with social class in classical terms of white/blue collar's type of work (Gonçalvez, 2020).

My topic: language and division of labor; a broad topic.

A Simplified Conceptual Framework

Skills. Concept related to the field of work-labor. Survive at work

Competences. Concept related to the field of education. Survive at school system

Literacy(ies). Old and new concept related to the integration of Skills and Competences under a broader perspective. Survival at quickly changing society; uncertainness; mobility; social exclusion.

Literacy historically implies social status (Coulmas, 1992).

Today literacies are related to a adaptability to a changing society

Language: System of representation, interaction, calculating, communicating (Humans), also design and execution of algorithms (computers) and Person-Computer interaction (Protocoles-Scripts).

Results of this background:

Specific relations between different literacies at work has raised from our analysis at the Language & Occupations Project:

- B1. Literacy use organize workers across occupational classifications better than numeracy use (Ubalde & Alarcón, 2019)
- B2. Digital-informational literacy use explains wages better than literacy, numeracy and soft skills (Ubalde & Alarcon 2020)
- B3. There are strong gaps on literacy and numeracy among men and women (Corbella et al. 2021)
- B4. Bilingualism as, generally, not valuable asset in the labor market (at USA) due to ethnification and discrimination of immigrant or relative poor conuntries (Ubalde & Heyman 2021, Alarcón et al. 2014

2. Theory and Main Hypothesis

- Across History, written **language** has created **social differentiation** (Coulmas 1992:36).

- Development of industrialization created high differences between those with administration tasks implying literacy and those with manual tasks (Ayuso and Arata 2009 for an historical review).

- Today it‘s observable an **institutionalization** of a wide set of literacies (digital literacies, intercultural literacies, numeracy, professional and STEM literacies, **among others – Humanities? Obviously language, L2…**) as intrinsic elements of key competences for lifelong learning oriented to achieve both **individual and collective prosperity** (European Commission [EC] 2018).

- The **main hypothesis is that language part of literacies** (speaking, writing, reasoning, discussing…) **has better explanatory power of social stratification** in occupation than some micro-skills (STEM), as numeracy or engineering

- In spite of the relevance of these new STEM literacies, our thesis is that literacy understood as **writing, reading and verbal skills** in, at least, mother tongue, **remains as the main stratifying factor of occupations in developed societies.**

3. Inductive: Quantitative and taxonomy analisys

(Thanks to Josep Ubalde and Natxo Sorolla)

3.1. **Regressions and PCA rotated factor loadings**

Cognitive demands with PCA (Principal Components Analysis) rotated factor loadings (r >0.5). Based on O'NET (Department of Labor), US Sample **964 occupations 333 variables (skills)**

Item	Loading
S&E knowledge	
Engineering (IM)	0.84
Engineering (LV)	0.85
Technical design (IM)	0.72
Technical design (LV)	0.70
Mechanical (IM)	0.81
Mechanical (LV)	0.85
Physics (IM)	0.90
Physics (LV)	0.91
Chemistry (IM)	0.76
Chemistry (LV)	0.80
Numerical Skills	
Numerical reasoning (IM)	0.82
Numerical reasoning (LV)	0.74
Number facility (IN)	0.86
Number facility (LV)	0.80
Mathematics (IM)	0.85
Mathematics (LV)	0.80
Verbal-reasoning skills	
Written comprehe-nsion (LV)	0.52
Written expression (LV)	0.51
Oral comprehension (LV)	0.51
Problem sensitivity (IM)	0.52
Problem sensitivity (LV)	0.60
Problem solving (IM)	0.51
Problem solving (LV)	0.51
Deductive reasoning (IM)	0.54
Deductive reasoning (LV)	0.54
Inductive reasoning (IM)	0.60
Inductive reasoning (LV)	0.60
Critical thinking (IM)	0.57
Communicative abilities	
Oral Comprehension (IM)	0.62
Oral Expression (IM)	0.66
Speech clarity (IM)	0.63
Speech clarity (LV)	0.55
Active listening (IM)	0.62
Speaking (IM)	0.64
Communicate (IM)	0.62
Communicate (LV)	0.55
Creative abilities	
Originality (IM)	0.64
Originality (LV)	0.61
Thinking creatively (IM)	0.77
Thinking creatively (LV)	0.71
Innovation (IM)	0.62
Fluency of ideas (IM)	0.60
Fluency of ideas (LV)	0.57
Operations analysis (IM)	0.58
Operations analysis (LV)	0.56
Technology design (IM)	0.63
Technology design (LV)	0.65
Computer skills and knowledge	
Programming (IM)	0.70
Programming (LV)	0.65
Computers & electronics (IM)	0.81
Computers & electronics (LV)	0.76
Computers interaction (IM)	0.75
Computers interaction (LV)	0.78
Managerial skills	
Financial Resources (IM)	0.69
Financial Resources (LV)	0.68
Personnel Resources (IM)	0.70
Personnel Resources (LV)	0.65
Management (IM)	0.83
Management (LV)	0.75
Nurturing skills	
Service orientation (IM)	0.68
Service orientation (LV)	0.60
Assisting and caring (IM)	0.91
Assisting and caring (LV)	0.92
Foreign language knowledge	
Foreign Language (IM)	0.94
Foreign Language (LV)	0.95

Notes: Data are from O*NET (N=470 SOC occupations). For ease of exposition, Table 1 shows which items primarily loaded on each factor. The complete factor loading matrix could be requested to authors. IM= Importance and LV= Level.

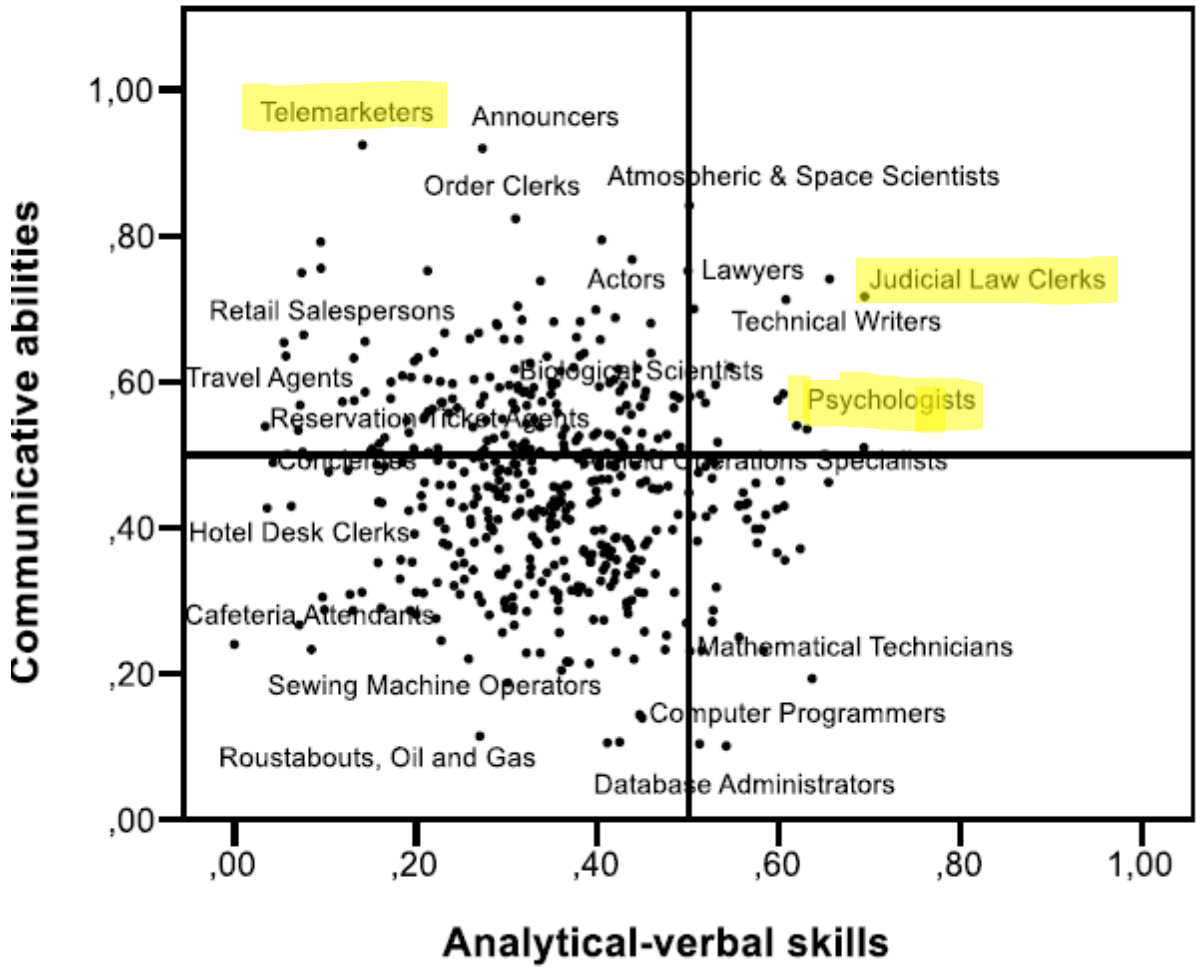
Estimated occupational-level effects on logged wages

Variables	Model 1	Model 2	Model 3
Intercept	2,791***(0.022)	0.179(0.135)	1,001***(0.185)
Verbal-reasoning		**1.334*****(0.091)**	**0.395*****(0.084)**
Communicative		0.338**(0.11)	-0.142*(0.086)
Foreign languages		0.475**(0.203)	-0.229(0.164)
Science & engineer.		0.472***(0.068)	0.299***(0.067)
Numerical		**1.021*****(0.109)**	**0.366*****(0.092)**
Creative		0.517***(0.08)	0.123*(0.069)
Informatics		**1.342*****(0.114)**	**0.556*****(0.091)**
Managerial		0.722***(0.082)	0.306***(0.068)
Nurturing		-0.062(0.07)	-0.116*(0.061)
English		0.083(0.129)	-0.023(0.095)
Autonomy			0.015(0.027)
Proportion female			0.048(0.047)
Prop. non white			-0.092(0.123)
Prop. Qualified			0.172***(0.062)
Unionization			-0.07(0.066)
Unemployment			-0.008**(0.003)
Individual-level variables	No	No	Yes
Individual variance	0.954***(0.006)	0.954***(0.006)	0.895***(0.006)
Occupational variance	0.177***(0.014)	0.037***(0.004)	0.037***(0.002)

Notes: O*NET and CPS. N=50,667 workers nested in 464 occupations. Dependent variable: Log adjusted hourly wages. Individual-level variables in model 3 are: gender, race, place of birth, age and age squared, marital status, region, area of residence, educational level, industry, sector, type of contract, membership of trade unions and survey participation year. In bold there are the linguistic variables and their coefficients.

* p<0.1; ** p<0.05; *** p<0.01

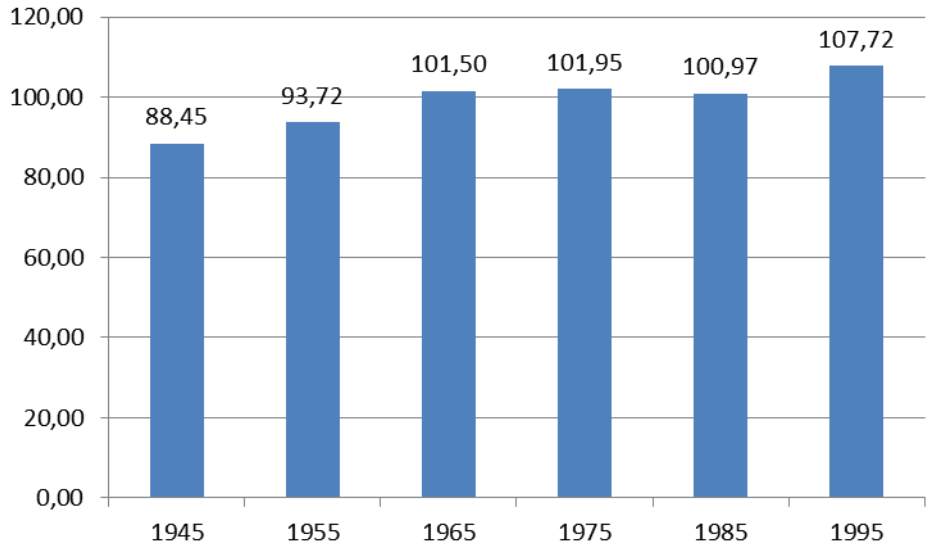
Illustrative occupations



Some controversies… literacy (classic term) is not an scarce resource?

Salary of Skilled blue collar vs Non-Skilled White collar

Salary of the highest ranked blue collars, regarding the non skilled white collars (%)



Source: Alarcon et al. (2022) Collective Agreements in Spain

3.2. Taxonomy: Results from factorial and clustering analysis

Inductive methodology

977 occupations and 333 varables (Knowledge, skills, abilities) analysed (O'NET)

Factor analysis

1st Factor Literacy vs Manual: (34,6% ofexplanation/variance)

2nd Factor STEM (Perception competence?) vs Others (12,16%)

3rd Factor Face-to-face vs computer-human interaction (7,1%)

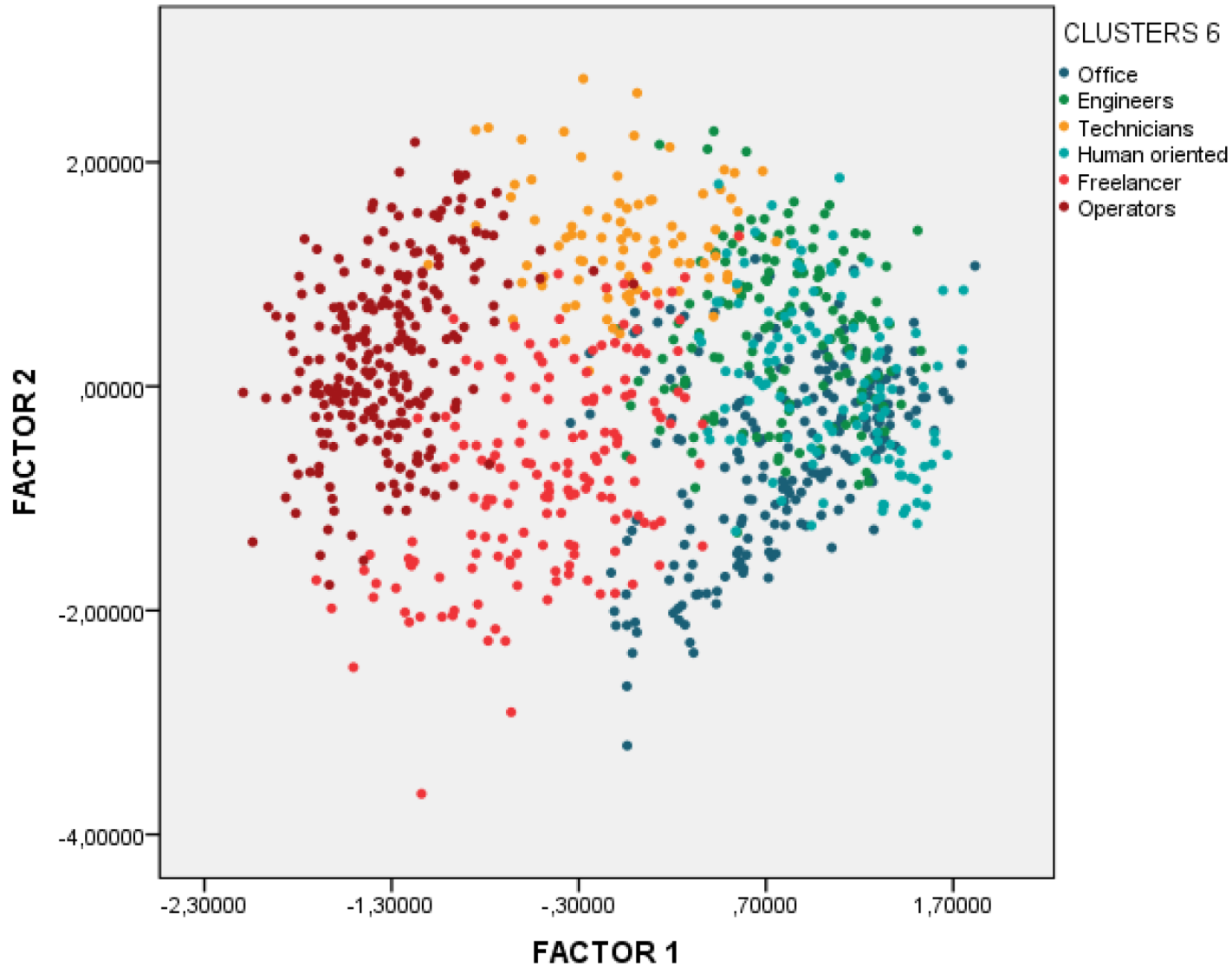
*Table 1 – Eigenvalues of 20 main variables of three first factors (or components) in factor analysis of occupation requirements of abilities, skills, knowledge, etc. Origin of data: O*Net.*

Component					
1		2		3	
1Ab_1.A.1.a.4_Written_Expressior	,854	3Kn_2.C.4.b._Physics._LV	,703	7WS_1.C.3.b_Concern_for_Others	,760
2Sk_2.A.1.d_Speaking_.LV	,851	1Ab_1.A.1.f.2_Visualization._LV	,672	7WS_1.C.4.a_Self_Control	,732
2Sk_2.A.1.c_Writing_.LV	,845	3Kn_2.C.4.b._Physics._IM	,663	7WS_1.C.3.c_Social_Orientation	,732
8WC_4.C.1.a.2.h_Electronic_Mail	,835	3Kn_2.C.3.b._Engineering_and_T	,658	8WC_4.C.1.d.3_Deal_With_Physi	,694
2Sk_2.A.1.b_Active_Listening_.LV	,826	3Kn_2.C.3.e._Mechanical._LV	,654	3Kn_2.C.5.b._Therapy_and_Coun	,651
2Sk_2.A.1.a_Reading_Comprehe	,823	2Sk_2.B.3.m_Quality_Control_Ana	,652	3Kn_2.C.5.b._Therapy_and_Coun	,651
6WV_1.B.2.c_Recognition	,823	2Sk_2.B.3.g_Operation_Monitorin	,648	8WC_4.C.1.d.2_Deal_With_Unple	,647
6WV_1.B.2.a_Achievement	,823	3Kn_2.C.3.b._Engineering_and_T	,620	3Kn_2.C.4.e._Psychology._IM	,631
1Ab_1.A.1.a.2_Written_Comprehe	,817	3Kn_2.C.4.c._Chemistry._LV	,619	6WV_1.B.2.d_Relationships	,620
1Ab_1.A.1.a.2_Written_Comprehe	,814	1Ab_1.A.1.e.3_Perceptual_Speed.	,613	5In_1.B.1.d_Social	,619
1Ab_1.A.3.a.1_Static_Strength._IM	-,787	8WC_4.C.1.d.2_Deal_With_Unple	-,113	2Sk_2.B.3.b_Technology_Design_	-,421
5In_1.B.1.a_Realistic	-,788	5In_1.B.1.e_Enterprising	-,126	3Kn_2.C.4.a._Mathematics._IM	-,424
1Ab_1.A.2.b.2_Multilimb_Coordina	-,790	7WS_1.C.3.c_Social_Orientation	-,131	2Sk_2.A.1.e_Mathematics_.IM	-,428
8WC_4.C.2.d.1.g_Spend_Time_U	-,791	3Kn_2.C.7.c._Fine_Arts._LV	-,140	2Sk_2.A.1.e_Mathematics_.LV	-,432
1Ab_1.A.3.c.1_Extent_Flexibility._I	-,794	3Kn_2.C.7.c._Fine_Arts._IM	-,154	3Kn_2.C.4.a._Mathematics._LV	-,468
1Ab_1.A.3.a.1_Static_Strength._LV	-,797	5In_1.B.1.h_Second_Interest_Hig	-,170	3Kn_2.C.3.c._Design._IM	-,479
1Ab_1.A.2.b.2_Multilimb_Coordina	-,797	5In_1.B.1.d_Social	-,201	3Kn_2.C.3.c._Design._LV	-,498
1Ab_1.A.2.a.2_Manual_Dexterity._	-,801	5In_1.B.1.f_Conventional	-,228	3Kn_2.C.3.b._Engineering_and_T	-,502
8WC_4.C.2.d.1.h_Spend_Time_B	-,818	8WC_4.C.2.d.1.i_Spend_Time_Ma	-,272	3Kn_2.C.3.b._Engineering_and_T	-,528
1Ab_1.A.3.c.1_Extent_Flexibility._L	-,823	5In_1.B.1.g_First_Interest_High-P	-,350	2Sk_2.B.3.e_Programming_.LV	-,536

*Table 2 – Punctuations of 20 main occupations of three first components in factors analysis of occupation requirements of abilities, skills, knowledge, etc. Origin of data: O*Net.*

Occupations in component...					
1		2		3	
Chief Executives	1,82	Airline Pilots, Copilots, and	2,74	Police Patrol Officers	2,91
Preventive Medicine Physici	1,75	Municipal Fire Fighting and	2,62	Sheriffs and Deputy Sheriffs	2,69
Neuropsychologists and Cl	1,75	Municipal Firefighters	2,31	Correctional Officers and Ja	2,48
Industrial-Organizational Ps	1,74	Forest Firefighters	2,29	Flight Attendants	2,48
Clergy	1,68	Robotics Engineers	2,28	Emergency Medical Techni	2,43
Counseling Psychologists	1,67	Ship and Boat Captains	2,27	Transit and Railroad Police	2,42
Education Administrators, P	1,65	Forest Fire Fighting and Pre	2,24	Municipal Firefighters	2,40
Neurologists	1,65	Pilots, Ship	2,20	First-Line Supervisors of Pc	2,35
Psychiatrists	1,62	Millwrights	2,18	Recreational Therapists	2,26
Business Teachers, Postse	1,60	Marine Engineers	2,16	Forest Firefighters	2,24
Tire Builders	-1,83	Shampooers	-2,27	Physicists	-2,24
Pile-Driver Operators	-1,84	Manicurists and Pedicurists	-2,27	Chemical Engineers	-2,26
Mine Cutting and Channelin	-1,84	Credit Checkers	-2,29	Statisticians	-2,35
Agricultural Equipment Ope	-1,86	Door-To-Door Sales Worke	-2,38	Fuel Cell Engineers	-2,39
Farmworkers and Laborers	-1,87	Telephone Operators	-2,38	Astronomers	-2,40
Rail Car Repairers	-1,92	Graders and Sorters, Agricu	-2,51	Mathematicians	-2,56
Roof Bolters, Mining	-1,96	Proofreaders and Copy Mar	-2,68	Computer Hardware Engin	-2,61
Helpers--Brickmasons, Blo	-1,97	Locker Room, Coatroom, a	-2,91	Software Developers, Appli	-2,62
Mine Shuttle Car Operators	-2,04	Telemarketers	-3,21	Photonics Engineers	-2,80
Fallers	-2,09	Models	-3,64	Mathematical Technicians	-2,96

*Figure 3 – Position of occupations depending their score in the first and second factors; and colored with cluster membership. Origin of data: O*Net.*



4. Brief Conclusion

- Skills are able to map all the labor market system in an a well defined new system of work in XXI Century
- But, we find obvious differences in the use of language and linguistic competences by occupations: white collar = language competences
- Language and linguistic competences (literacy) are the most important factors to both explain occupational prestige as well as to classify occupations
- Verbal-Analitycal Skills, Perception competence , new concepts created in the research, very demanded in the labor market
- We must keep working to fully understand the role of language skills in occupations

Some questions for the debate

- *White collar is "only" linguistic competence?*
- *What is the role of numeracy and/or STEM?*
- *And what about entrepreneurship? Or leadership?*